VOL. XII, NO. 1 AUGUST, 1944

PROCEEDINGS

OF THE

HAWAIIAN ENTOMOLOGICAL SOCIETY

FOR THE YEAR 1943

HONOLULU, HAWAII

PRICE $1.25

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All correspondence should be addressed to the Secretary, Hawaiian Entomological Society, 1527 Keeaumoku St., Honolulu 4, Hawaii, from whom copies of the Proceedings may be purchased.

The Hawaiian Entomological Society was founded on January 26, 1905, after a preliminary meeting held on December 15, 1904. The original members were:

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W. M. Giffard
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At the second regular meeting, held in February, 1905, Brother Matthias Newell of Hilo was elected to honorary membership. Since its founding, 456 meetings of the Society have been held, and eleven volumes of Proceedings published.

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PROCEEDINGS

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Hawaiian Entomological Society

Editor Emeritus, O. H. Swezey

VOL. XII, No. 1 FOR THE YEAR 1943 AUGUST, 1944

This issue of the Proceedings is the first ever to appear without Mr. O. H. Swezey as its editor. After nearly forty years, at his own request, Mr. Swezey has relinquished the direction of this periodical in order to devote himself more fully to his studies of the native Hawaiian insect fauna. Under his editorship the Proceedings attained a position unique among journals of its kind, and constitutes an enduring monument to Mr. Swezey's long devotion to Hawaiian entomology. The amount of work he devoted to the production of the Proceedings cannot be fully appreciated by most of us. We know, however, that he has given to it the same fresh interest and zest which all phases of entomology claim from him. For the Society we wish to express our appreciation of his long and efficient service as editor, and the hope that as Editor Emeritus, he will continue for many years to counsel his successors on the editorial committee.

JANUARY 11, 1943

The 445th meeting was held at the H.S.P.A. Experiment Station on Monday, January 11, at 2:00 p.m., with President Holdaway in the chair.

Members present: Messrs. Faxon, Fullaway, Holdaway, Krauss, Look, Marlowe, McBride, Nishida, Pemberton, Rosa, Sakimura, Stains, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

Visitor: Lt. R. L. Doutt, U.S.N.

NOTES AND EXHIBITIONS

Records from Kauai—Mr. Krauss presented the following data on material collected on Kauai: *Stenotrupis marshalli* Zimmerman; one specimen of this small weevil was taken at Lihue on October 18, 1942. Hitherto it has been recorded only from the island of Oahu and from Samoa. The specimen was identified by Mr. Zimmerman. *Latrodectus geometricus* Koch; found fairly abundant in

a rocky bank near the pier at Port Allen on October 16, 1942; identified by Prof. R. V. Chamberlin of the University of Utah. *Tetranychus* sp., identified by Mr. E. A. McGregor of the U.S. Bureau of Entomology and Plant Quarantine; collected on taro (*Colocasia esculenta* Schott) at Kapaia on October 20, 1942, and on cotton at Nawiliwili on the same date.

Cyrtopeltis varians (Distant)—Mr. Krauss reported finding nymphs and adults of the tomato bug abundantly on several plants of the wild spider flower (*Gynandropis pentaphylla* De Candolle) in Honolulu on December 24, 1942.

Thysanoptera from Maui—Mr. Krauss reported the collection on Maui of the following thrips, all identified by Mr. Sakimura: *Taeniothrips frici* Uzel, on the flowers of the common dandelion (*Taraxacum officinale* Weber) at an elevation of 9,000 feet on Haleakala, April 14, 1940. The Hawaiian thrips, *Thrips hawaiiensis* (Morgan), the composite thrips, *Microcephalothrips abdominalis* (Crawford), and *Haplothrips gowdeyi* (Franklin), were found on flowers of the golden crown-beard, *Verbesina encelioides* (Cav.) Benth. & Hook., at Makena on the same date.

Acrodrepanis megalophylla (Meyr.)—A male specimen of this rare moth was exhibited by Mr. Swezey. He had found it among other unidentified material which he was recently examining. The specimen had a pencilled label as from Kilauea, Hawaii, collected by Dr. R. C. L. Perkins, without date, but it must have been collected sometime before 1904. There has been no specimen of this moth hitherto in the H.S.P.A. collection.

Hydriris exaucta (Meyr.)—Mr. Swezey exhibited a specimen of this rare pyralid moth similarly found among unidentified material as above. Its pencilled label was Kukuihaele, Hawaii, but without date or collector's name. It was most probably collected by Dr. Perkins at an early date. The species was described in the Proceedings of the Society (7 (1) : 95, 1928) from specimens collected at Kaholuamano and Kokee, Kauai, 1920 (Kusche), and Halehaku, Maui (Bryan). The present record would extend its range to the island of Hawaii. Presumably this is an endemic species. It was not previously represented in the H.S.P.A. collection.

Parasitism of *Plusia* by *Litomastix*—Mr. Swezey reported on some recent records of parasitism by the polyembryonic encyrtid, *Litomastix floridana* (Ashmead), on *Plusia chalcites* (Esper) caterpillars collected in the field at various localities on Oahu. *Plusia* caterpillars had been scarce for quite a time, but had become more prevalent during a recent rainy spell, and parasitism has been quite pronounced.

Dec. 12. Experiment Station, H.S.P.A., seven caterpillars on *Emilia* were 43 per cent parasitized.

Dec. 20. 2044 Lanihuli Drive, Manoa, ten caterpillars on sweet-potato leaves were 80 per cent parasitized.

Dec. 21. Ewa Plantation, 19 caterpillars collected on the weed, *Verbesina,* by F. X. Williams, were 10 per cent parasitized.

Dec. 31. Ewa Plantation, 22 caterpillars on an unidentified weed (Williams), were 9 per cent parasitized.

Jan. 7. Waialua Agricultural Company, Mill Field no. 9, 15 caterpillars collected on lima beans (Van Zwaluwenburg) were 80 per cent parasitized.

Eucelatoria armigera (Coq.)—Mr. Swezey reported rearing this tachinid fly from *Plusia chalcites* caterpillars collected by Dr. Williams on weeds at Ewa Plantation, Dec. 21 and 31. Of 19 caterpillars collected on Dec. 21, 31 per cent were parasitized by this tachinid. Of 22 collected Dec. 31, 41 per cent were parasitized. These are the first rearings of this fly from field material in Hawaii.

Mongoose capturing a monarch butterfly—Dr. Williams stated that on January 10, at his house in upper Keeaumoku Street, two nearly grown mongooses were seen at the edge of tall grass. Presently a monarch butterfly, *Danaus plexippus* (Linn.), fluttered low nearby. One of the mongooses became somewhat interested and followed the insect for a while, but when the butterfly, hovering at a low weed, drew the attention of the second mongoose, the latter rushed at it and caught it in its jaws, seizing, in the act, a bit of plant leaf at which the butterfly had been pausing. The mongoose made away with its prize in the tall grass.

FEBRUARY 8, 1943

The 446th meeting was held at the H.S.P.A. Experiment Station on Monday, February 8, at 2:00 p.m., with President Holdaway in the chair.

Members present: Messrs. Fullaway, Holdaway, Illingworth, Krauss, Look, Marlowe, McBride, Nishida, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

Visitor: Thomas Farr, U.S.N.

PAPERS

Mr. Swezey presented, and discussed briefly, two papers entitled: "Synonymy of Euxoa hephaestaea (Meyrick)", and "The Kou Moth, Ethmia colonella Walsm., in Hawaii".

NOTES AND EXHIBITIONS

Apanteles marginiventris (Cresson)—Mr. Pemberton spoke of the establishment of this armyworm parasite on the grounds of the H.S.P.A. Experiment Station, from specimens reared by Dr. Wil-

liams from material sent in last year from Brownsville, Texas by F. A. Bianchi. Some of these wasps, including a number that had already been used in oviposition on caterpillars, had been liberated on the Station grounds, with the result that their cocoons were found on nutgrass in January, and wasps hatched from them.

Eucelatoria armigera (Coq.)—Mr. Van Zwaluwenburg told of rearing this tachinid fly on nutgrass armyworm larvae, *Laphygma exempta* (Walker) in the laboratory. The ready acceptance by *Eucelatoria* of *Laphygma* caterpillars gives promise of value in controlling this pest in the field. The female fly deposits nearly mature maggots within the host, by means of a thorn-like larvipositor, and the life cycle is extremely short. In this connection Mr. Swezey described his discovery of the way in which our larger tachinid, *Chaetogaedia monticola* (Bigot), parasitizes noctuid caterpillars. The fly oviposits on vegetation which by chance may be eaten by a caterpillar, which ingests the *Chaetogaedia* egg without harm to the latter, but eventually with dire results to itself.

Records from Palmyra Island—Mr. Krauss reported the following interceptions made on March 20, 1942 at the Honolulu Plant Inspection Office in a shipment of bird's-nest ferns (*Asplenium* sp.) from Palmyra Island: one earthworm; four sowbugs (*Philoscia* sp.; det. J. O. Maloney, U.S. National Museum); and one immature spider (*Heteropoda* sp.; det. R. V Chamberlin, University of Utah).

Graptostethus nigriceps Stål—Mr. Krauss reported finding two specimens of this bug on January 18, 1943 in a package of woodrose pods (*Ipomoea tuberosa* Linn.) being mailed to the mainland. On January 19 two more were collected on the foliage and pods of this plant at 3066 Wailani Road, Pacific Heights, Honolulu, where the mail shipment had originated.

Aphis gossypii Glover—Mr. Krauss reported collecting the cotton or melon aphis at the following places on Kauai: on sweet potato at Lawai-kai, October 19, 1942; on taro (*Colocasia esculenta* Schott) at Kapaia, October 20; on cotton at Waimea, October 23; and on cucumber at Hanapepe, October 28. The specimens were identified by Dr. P. W. Mason, U.S. Bureau of Entomology and Plant Quarantine.

MARCH 8, 1943

The 447th meeting was held at the H.S.P.A. Experiment Station on Monday, March 8, at 2:00 p.m., with President Holdaway in the chair.

Members present: Messrs. Holdaway, Krauss, Look, Marlowe, McPhail, Nishida, Pemberton, Rosa, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

Visitors: Messrs. T. C. Russell and Y. Tanada.

PAPER

Mr. Look presented a paper by himself and Mrs. Ethel Lucas McAfee entitled: "Some First Records of Aphids in Hawaii".

NOTES AND EXHIBITIONS

Grasshoppers feeding on Irish potato—Dr. Holdaway and Mr. Look exhibited plants of Irish potato showing the injury by three species of grasshopper, *Conocephalus saltator* (Sauss.), a long-horned grasshopper, and *Atractomorpha ambigua* Bolivar and *Oxya chinensis* (Thunb.), short-horned grasshoppers. The attack by *Conocephalus* consisted of large holes in the leaves, and was concentrated on the younger leaves of the plant. Attack by *Atractomorpha* consisted of holes of irregular shape, but in general not as large as those made by *Conocephalus*. Attack by *Atractomorpha* was concentrated on the older leaves. Attack by *Oxya* consisted of removal of the distal end of several leaflets and complete removal of two mature leaves, completely severed from the plant; the leaf petioles were cut through near the main stem.

The injury done by each species was the result of accumulated feeding over a period of four days, all species having been introduced at 1:00 p.m., March 4. *Atractomorpha* had begun feeding immediately it was introduced into the cage with the potato plant. *Conocephalus* had not fed for three hours after introduction, but was feeding the following morning, 19 hours after introduction. *Oxya* did not feed on the potato plant during the first two days. The injury described was found on the fourth day but may have been made any time between the second and fourth day.

This is not the first time injury by these grasshoppers has been secured under controlled conditions. On one previous occasion *Oxya* had severed the main stem, causing injury comparable to that made by a large cutworm on Irish potato.

In the annual report for 1940 of the Hawaii Agricultural Experiment Station (p. 39) reference was made to the fact that *C. saltator* and *O. chinensis* had attacked the foliage of Irish potato. The correctness of these observations was questioned by some local entomologists. It was pointed out, as indicated by Dr. Williams in his "Insects and Other Invertebrates of Hawaiian Sugar Cane Fields", that *Oxya* fed on the leaves of sugar cane and grasses, while *Conocephalus* prefers an insect to a vegetable diet, and thrives upon leafhoppers and aphids. It was stated that the alimentary tract of *C. saltator* did not normally contain chlorophyll-bearing plant tissue. Williams, however, refers to the fact that it feeds to a slight extent on the margin of leaves of rice and on pineapple.

The observations here described, and the injury exhibited, indicate that all three species will feed on the foliage of Irish potato. Individuals of *C. saltator* are common in potato fields. Further

observations may indicate the conditions under which attack occurs.

Phyllocoptes destructor Keifer*—Dr. Holdaway reported the occurrence of the tomato russet mite on tomato on the islands of Oahu and Maui. This eriophyid was first observed and collected on tomato plants in the garden of Dr. F. G. Krauss, Parker Place, Manoa Valley, Honolulu, May 26, 1942. Additional records are the following:

Waimanalo, Oahu, on tomato, Sept. 8, 1942, coll. F. G. Holdaway; Pensacola substation, H.A.E.S., Honolulu, on tomato, Nov. 7, 1942, coll., Wm. C. Look; Omaopio, Maui, on tomato, Nov. 23, 1942, coll. F. Murphy. The plants on which this mite was collected at Manoa Valley were young plants which were so severely attacked they would have succumbed if control measures had not been adopted promptly. The plants infested at Waimanalo were severely attacked and production was prevented. Some of the plants in this field were also attacked by broad mite, *Hemitarsonemus latus* Banks. At Waimanalo the weed, *Solanum nodiflorum* Dunal (*S. nigrum* Linn.), was also infested by *P. destructor*. Mr. Murphy, who collected the specimens on Maui, reported that the mite was causing severe damage and about 90 per cent loss of the crop. All the specimens collected on Oahu have been identified by H. H. Keifer.

The occurrence of *P. destructor* in Hawaii has already been referred to by Dr. Schmidt (Proc. Haw. Ent. Soc., **11** (3): 275, 1943). The specimens on which Dr. Schmidt's record is based were collected Sept. 22, 1942, at a place only a few blocks from where the specimens collected last May were taken. Two of the records given above, however, antedate Dr. Schmidt's record. It would appear that this mite has become established in Hawaii comparatively recently. Its establishment on the island of Maui follows rapidly on its introduction to Oahu.

Erinose mite of litchi—Dr. Holdaway and Mr. Nishida reported that specimens of the erinose mite of litchi (*Litchi chinensis* Sonn.), hitherto apparently unidentified, had been submitted to Dr. Keifer for determination. He has replied that it is *Eriophyes chinensis* Trotter,† but that the species has never been adequately described. With the material forwarded to him he is now proceeding to draw up figures of the species.

Leaves of litchi exhibiting the characteristic felting were examined during the period between August 31 and November 10, 1942 without their yielding evidence of the presence of mites. On November 10, leaves from trees which had been examined during the previous months were found heavily infested with the mites.

* Described in "Eriophyid Studies X", Bull. Cal. Dept. Agr., **29**: 161-162, fig., 1940.

† Dr. Keifer has since described the litchi mite of Hawaii as *Eriophyes litchii* ("Eriophyid Studies XIII", Bull. Cal. Dept. Agr., **32**(3): 212, pl. 171, July-September, 1943). (Ed.)

Evidence of the presence of mites in numbers has continued to be secured up to February. The lack of evidence of mites during the late summer months and their appearance in numbers in November, when the fall rains began, suggested a periodicity of broods possibly associated with the rains and the flush of new growth.

Lema trilineata californica Schaeffer—Mr. Krauss presented the following note on the three-lined potato beetle. Adults, larvae and egg masses were found abundantly on the solanaceous weed, apple of Peru (*Nicandra physaloides* Gaertner), in Kaimuki, Honolulu on February 26, 1943. This is a new host record. The following are unpublished early records of this species: the first specimens found in the Islands were collected on poha (*Physalis peruviana* Linn.), in the back yard of a house on Johnson Lane (off Liliha Street, above Vineyard), Honolulu, on September 15, 1933 by Miss F. Segawa, a university student. These were the specimens recorded without details in the Proceedings of the Society (**8** (3): 389, 1934). Masao Nakano, another university student, collected about ten specimens at night in a house on Enos Lane in the Makiki district of Honolulu, some time between October 20 and 29, 1933. On March 6, 1934 Mr. Krauss found adults, larvae and egg masses on leaves of the angel's trumpet, *Brugmansia arborea* (Linn.), in the grounds of the Territorial Office Building, Honolulu, and on March 29 adults, larvae and egg masses were found on leaves of the jimson weed (*Datura stramonium* Linn.) on the University of Hawaii campus. This beetle is now established on the islands of Oahu, Kauai, Maui, Molokai and Hawaii. Besides the hosts noted above, it has been found breeding on *Datura metel* Linn., *D. tatula* Linn., cup of gold (*Solandra guttata* Don), Irish potato, and *Physalis mollis* Nuttall. Mr. Pemberton remarked that he had found this beetle on tobacco at the H.S.P.A. Experiment Station in Makiki.

Elimaea punctifera (Walker)—Mr. Krauss reported finding several nymphs of this narrow-winged katydid feeding on buds and flowers of azalea plants growing outdoors in pots in Manoa Valley, Honolulu, on March 1, 1943. The flowers were entirely ruined.

Telmatoscopus albipunctatus (Williston)—Mr. Russell spoke of the abundance, in annoying numbers, of this large psychodid moth-fly at the Naval hospital at Aiea, Oahu. The larvae were very numerous among rocks forming the filter for the sedimentation basin for the water supply.

APRIL 12, 1943

The 448th meeting was held at the H.S.P.A. Experiment Station on Monday, April 12, at 2:00 p.m., with President Holdaway in the chair.

Members present: Messrs. Faxon, Goolsby, Holdaway, Krauss, Look, Nishida, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

Visitor: Yoshinori Tanada.

PAPER

Mr. Look and Mrs. Ethel Lucas McAfee presented a paper entitled: "New Host Records of Aphids in Hawaii."

NOTES AND EXHIBITIONS

Nymphula obliteralis (Walker)—Mr. Swezey reported rearing the water lily moth from larvae feeding on water lily leaves in the pond at Central Union Church on Beretania Street, a new locality for the occurrence of this moth.

Hydra viridis Linn.—Mr. Swezey reported finding this fresh water hydra on the under side of lily leaves in the lily pond in the Central Union Church grounds in March of this year, and again today. Six were found on one leaf. It is the second place he has seen *H. viridis* in Honolulu; the first was in Moanalua gardens in 1916 on a water lily leaf.

"Insects of Guam—I"—Mr. Swezey called to attention that in a mention of this publication in Experiment Station Record (**88** (2): 218, Feb. 1943), the statement: "The list is said to contain about 50 species not known to occur in Hawaii", is misleading. In the reviewer's paragraph the statement is in reference to "Insects of Guam—I", which contains 361 species, whereas it actually should refer to a previously noted paper on "A Survey of the Insect Pests of Cultivated Plants in Guam", published in The Hawaiian Planters' Record (**44** (3): 151-182, 1940), and reviewed in Experiment Station Record (**84** (3): 358, March 1941).

Tachinid parasites taken in wind traps—Mr. Sakimura presented the following: Wind trap data from Kunia, Oahu, pineapple fields, showed that through the summer up until the end of October 1942, there was practically no flight of tachinid flies or of their hosts. Now, after very active flight during the five months from November 1942 to March 1943, they have practically disappeared. The tachinids caught during the five-months period were: 111 *Eucelatoria armigera* (Coq.) (two-thirds males); 14 *Frontina archippivora* (Williston) (one-half males); 13 *Chaetogaedia monticola* (Bigot) (one-quarter males); and 1 *Archytas cirphis* Curran. The moths caught were: 169 *Laphygma exempta* (Walker); 43 *Lycophotia margaritosa* (Haworth); 29 *Plusia chalcites* (Esper); and 3 *Cirphis unipuncta* (Haworth). After heavy rain during November, followed by the wet months of December and January, *L. exempta* appeared in outbreak numbers, with the peak of flight during December and January. A short active flight of

P. chalcites occurred during January, and of *L. margaritosa* during February. *Eucelatoria* suddenly appeared in a large group during January and February. An occasional flight of *Frontina* was observed during December, January and February, while flights of *Chaetogaedia* occurred throughout the five months. The number of species attacked by each parasite is difficult to determine from the present data. It is noteworthy that *Eucelatoria* was the predominating tachinid in the area during the period covered by these notes. Messrs. Swezey and Van Zwaluwenburg were consulted for the determination of the species.

Synonymy of some Hawaiian Staphylinidae—Mr. Van Zwaluwenburg called attention to some recent synonymy among immigrant species of Hawaiian staphylinids. In his "Monograph of the West Indian Beetles of the Family Staphylinidae" (U.S. National Museum Bull. **182,** 658 pp., 1943) Dr. R. E. Blackwelder discusses five widely distributed species which are known from Hawaii as well as from the area under consideration. Only one of these, *Philonthus discoideus* (Gravenhorst), is retained under the name familiar to Hawaiian entomologists. The other four are either referred to other genera or synonymized as follows:

Trogophloeus senilis Sharp 1880 is a synonym of *Carpelimus fulvipes* (Erichson) 1840 (pp. 62-63).

Oxytelus ferrugineus Kraatz 1859 (*O. bledioides* Blackbn. & Sharp 1885) is referred (pp. 96-98) to *Oxytelus incisus* Motschulsky 1857.

Ancaeus laevigatus (Kraatz) 1859 (*Lispinodes pallescens* Blackbn. 1885) is synonymized (pp. 158-160) under *Paralispinus exiguus* (Erichson) 1840.

Medon debilicornis (Wollaston) 1857 is referred (pp. 267-269) to *Sunius debilicornis* (Wollaston).

Triatoma rubrofasciata (Degeer)—Mr. Pemberton reported a case of this bug biting a woman at Kaimuki, Honolulu, during March and April 1943, and causing severe pain and swelling on one side of the face and one arm, accompanied by pronounced reddish blotches on the skin. Numerous small reddish spots appeared on the face and arm where the bug had evidently fed. Illness persisted for three weeks. A search of the bed where the woman slept resulted in finding the bug, the abdomen of which was greatly distended with blood.

Euscepes postfasciatus (Fairmaire)—Mr. Pemberton reported finding this weevil extensively breeding in the fleshy roots of *Ipomoea triloba* Linn., near Aiea, Oahu, on March 18, 1943. This morning-glory vine has not previously been reported in Hawaii; it was identified by E. L. Caum.

Haplogonatopus vitiensis Perkins—Mr. Pemberton reported observing a number of small, white cocoons attached to the dried silk

on corn ears in a field at Kailua, Oahu, on Feb. 19, 1943. These were collected and from them, later, emerged adults of this dryinid. Previously known hosts of this parasite of delphacids have been the sugar cane leafhopper (*Perkinsiella saccharicida* Kirkaldy), the taro leafhopper (*Megamelus prosperina* Kirkaldy), both in Hawaii, and a delphacid on grass in Fiji, possibly different from *P. saccharicida*. Finding the cocoons on corn suggested that the parasite was breeding on the corn leafhopper (*Peregrinus maidis* [Ashmead]). Subsequently the adult dryinids which emerged from the cocoons readily parasitized corn leafhoppers confined with them, and normal adults were reared from this material.

Anthonomus eugenii Cano—Mr. Krauss reported finding fruits of the purple-fruited cherry pepper (*Capsicum frutescens cerasiforme* [Mill.]) heavily infested with pepper weevil larvae in the Kapalama district of Honolulu on March 23, 1943.

Walnut insects—Mr. Krauss reported that *Ephestia cautella* Walker, the almond moth, and *Oryzaephilus surinamensis* (Linn.), the saw-toothed grain weevil, were found abundantly in a package of unshelled walnuts which had been stored for some time by a resident of Honolulu. The nuts were entirely ruined.

Laphygma exigua (Hübner) on Johnston Island—Mr. Krauss reported that larvae of this species, the beet armyworm, were submitted for determination by a naval officer who reported them as doing severe damage, during the early part of April 1943, to ornamental shrubs and vines on Johnston Island, lying southwest of the Hawaiian group.

Maruca testulalis (Geyer) in *Gliricidia* flowers—Mr. Goolsby submitted the following: In February, when *Gliricidia sepium* (Jacq.) Steud. trees first began flowering, two or three short stems of blossoms were collected from trees growing near Pearl City, about a half-mile from the highway on the old Honolulu road. These were placed in a cage, and on March 1 adult moths began emerging. Ten *Maruca testulalis* adults emerged, and 11 larvae and pupae died in the cage. One *Lampides boeticus* (Linn.) (the bean lycaenid butterfly) and one *Amorbia emigratella* Busck also emerged from the lot. Early in March, four stems of flowers about six inches long were taken and caged. From these, 15 *Maruca* adults emerged, and one *Amorbia*. Again the mortality of larvae and pupae was about 50 per cent. Thus, in six or seven short stems of *G. sepium* flowers, about 50 *Maruca* were feeding. From one tree thousands of these insects would emerge during the flowering season, and it seems probable that such an increase might have a noticeable effect upon the infestation of crops such as string and lima beans.

Graptostethus nigriceps Stål—Dr. Williams spoke of finding a specimen of *G. nigriceps* on the outside of a laboratory window at

the H.S.P.A. Experiment Station, Honolulu, on March 31, 1943. This chiefly red and black lygaeid bug has but recently been taken here.

MAY 10, 1943

The 449th meeting was held at the H.S.P.A. Experiment Station on Monday, May 10, at 2:00 p.m., with President Holdaway in the chair.

Members present: Messrs. Faxon, Holdaway, Krauss, Look, Marlowe, Nishida, Pemberton, Rosa, Sakimura, Stains, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

Visitor: Yoshinori Tanada.

Dr. Holdaway nominated Mr. Yoshinori Tanada for membership in the Society.

NOTES AND EXHIBITIONS

New insect records from Kauai—Mr. Krauss presented the following list of insects taken on Kauai in October 1942, none of which apparently has been recorded before from that island:

Orthoptera:

Tenodera angustipennis Saussure. Chinese mantid; egg case collected Nawiliwili, October 20.

Coleoptera:

Amphicerus cornutus (Pallas); Waimea, October 23, in dead branches of kiawe, *Prosopis chilensis* (Molina) Stuntz.

Bruchus limbatus Horn; Waimea, October 23.

Calandra linearis (Herbst); tamarind weevil, Waimea, October 23.

Carpophilus hemipterus (Linn.); dried-fruit beetle, Nawiliwili, October 21.

Oryzaephilus surinamensis (Linn.); saw-toothed grain beetle, Lihue, October 15.

Pantomorus godmani (Crotch); Fuller's rose beetle, Waimea, October 23.

Platyomus lividigaster Mulsant; yellow-shouldered ladybeetle, Anahola, October 26.

Scymnus notescens Blackburn; Hanapepe, October 28.

Tribolium ferrugineum (Fabr.); rusty flour beetle, Nawiliwili, October 21.

Calandra granaria (Linn.)—Mr. Krauss exhibited two specimens of the granary weevil collected in a Honolulu grain and feed warehouse April 29, 1943, together with a number of rice weevils, *Calandra oryzae* (Linn.). The granary weevil is apparently very seldom found in the Hawaiian Islands.

Eucelatoria armigera (Coq.)—Mr. Van Zwaluwenburg presented the following: Laboratory breeding of this recently established tachinid fly, on *Laphygma exempta* (Walker) larvae, showed no correlation between the sex ratio of the adult flies and the number of maggots per individual host. From 54 *Laphygma* larvae the following data were obtained:

			Per cent males
13 larvae produced 1 puparium each:	8 males and 5 females issued		61
16 larvae produced 2 puparia each:	17 males and 11 females issued		60
9 larvae produced 3 puparia each:	13 males and 13 females issued		50
2 larvae produced 4 puparia each:	5 males and 3 females issued		62
10 larvae produced 5 puparia each:	16 males and 23 females issued		41
1 larva produced 6 puparia each:	4 males and 1 female issued		80
1 larva produced 7 puparia each:	6 males and 0 females issued		100
2 larvae produced 8 puparia each:	6 males and 8 females issued		42
TOTAL:	76 males and 64 females issued		53.9

A total of 176 *Eucelatoria* from *Laphygma,* including those tabulated above, as well as some for which the number of puparia per host was not recorded, showed a total of 86 males and 90 females, or 48.8 per cent males. An illustrated account of *Eucelatoria* appears in The Hawaiian Planters' Record, **47** (2): 81-87, 1943.

Hemitarsonemus latus Banks—Dr. Holdaway and Messrs. Look and Nishida exhibited several economic plants showing symptoms of injury by the broad mite: papaya, beet, chard, pepper and green bean.

Phyllocoptes destructor Keifer—The following new records of occurrence on Oahu, of the tomato russet mite were contributed: University of Hawaii campus, by Mr. Nishida; McKinley School garden, by Dr. Holdaway; and Kalihi, by Mr. Look.

JUNE 14, 1943

The 450th meeting was held at the H.S.P.A. Experiment Station on Monday, June 14, at 2:00 p.m., with President Holdaway in the chair.

Members present: Messrs. Fullaway, Goolsby, Holdaway, Hyslop, Krauss, Look, Marlowe, McBride, Nishida, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

Visitor: Franklin Sherman III, Capt., Sanitary Corps.

Mr. Yoshinori Tanada was elected to membership in the Society.

By unanimous vote the Treasurer was instructed to send, on behalf of the Society, the sum of $25 to the Zoological Society of London as a contribution to the financing of the Zoological Record.

NOTES AND EXHIBITIONS

Xyletobius aleuritis Perkins—Mr. Swezey exhibited a specimen of this rare anobiid beetle which he had cut out of a dead spot in a kukui (*Aleurites moluccana* Willd.) trunk in Ukumehame Valley, Maui, August 29, 1929. It had been collected previously only on Oahu, first by Dr. Perkins in April 1892: two examples dug out of dead kukui wood at a low elevation in the Waianae Mts. The next collection on Oahu was by O. H. Swezey in Makaleha Valley, Feb. 1, 1931: eight beetles from a standing dead kukui tree very much honeycombed by the larvae. Then again by Swezey in Kamokunui Valley, Oct. 1, 1933: two beetles under bark of *Pipturus*. The specimens of these last two collections were determined by Dr. Perkins (Proc. Haw. Ent. Soc., 9 (1) : 87, 1935). Dr. Perkins states that: "The species is very different from any other and is not really congeneric with any Hawaiian anobiid". It is much larger than any other species of *Xyletobius* except one, *durranti* Perkins.

Lycophotia margaritosa (Haworth)—Mr. Swezey exhibited a variegated cutworm moth which was reared from a caterpillar found feeding in green tomatoes. Four of the caterpillars were found by Mr. Wm. Weinrich in tomatoes growing in a specially constructed screen house on Kewalo Street, May 15, 1943. One moth matured June 11. The other caterpillars were pickled. At first it seemed quite a mystery how these caterpillars could gain access to the screened house. The only feasible explanation seemed to be that an egg cluster had been deposited on a leaf of overhanging branch of avocado tree, as it is known that this moth has the oviposition habit of placing its eggs on leaves which may not necessarily be the normal food of the caterpillars. In this instance some of the young caterpillars, on hatching, may have dropped by spun thread to the screen roof of the house and gained access, where they at first had fed on the tomato leaves, and later attacked the green fruit. Apparently there is no previous record in Hawaii of caterpillars of this moth attacking green tomatoes.

JULY 12, 1943

The 451st meeting was held at the H.S.P.A. Experiment Station on Monday, July 12, at 2:00 p.m., with President Holdaway in the chair.

Members present: Messrs. Carter, Faxon, Fullaway, Holdaway, Krauss, Look, Marlowe, McBride, Nishida, Pemberton, Rosa, Sakimura, Swezey, Tanada, Van Zwaluwenburg, Williams and Zimmerman.

Visitor: Thomas W. Cook.

NOTES AND EXHIBITIONS

Cryptorhynchus mangiferae (Fabr.)—Mr. Swezey reported some observations on the present prevalence of the mango weevil. He had examined the seeds from mangoes which were eaten at different times as they fell from a heavily loaded mango tree on Lanihuli Drive, Manoa Valley, June 13 to July 9, 1943. Altogether 379 seeds were examined, and 90 per cent of them contained weevils in one stage or another: small larvae, 6 per cent; full grown larvae, 28 per cent; pupae, 40 per cent; mature beetles, 25 per cent. Some of the seeds contained more than one weevil: 26 per cent contained two weevils, and 4 per cent contained three weevils. As these mangoes were larger than usual for this particular tree, and were better flavored than usual, it would appear that having this high infestation of the seeds by the mango weevil was not detrimental to the fruit, nor had it caused premature dropping of the fruit. There has been some expression of opinion that the weevils caused premature dropping of fruit and undersized fruit. This is not borne out by the present observation. As a check in regard to this, fallen immature fruits from an adjacent tree were examined and the seeds of 83 per cent of them contained no weevils, though they were found in 67 per cent of the seeds of the fully matured fruit that fell from the same tree.

Graptostethus nigriceps Stål—Mr. Swezey reported having collected an adult of this new immigrant lygaeid bug on hibiscus in his garden, 2044 Lanihuli Drive, Manoa Valley, June 26, 1943. Mr. Look exhibited another adult taken on eggplant at the Puuhue Victory garden (Kalihi district), Honolulu on May 15; no nymphs were present. Both these records are additional stations in the spread of this insect.

Hercothrips fasciatus (Pergande)—Mr. Sakimura reported that the long-feared establishment of the California bean thrips in these Islands, must now be recorded. *H. fasciatus* was found among a series of thrips recently collected by Mr. Krauss on Molokai. He collected, on June 4, 1943, a large number of specimens from leaves, flowers and buds of prickly poppy (*Argemone glauca* Linn.) growing along the roadside near Kaunakakai. The present limits of this insect's distribution are not yet known. Identification of the material was verified by Mr. Dudley Moulton.

Frankliniella sp.—Mr. Sakimura reported that this species, common on Oahu, was recently collected by Mr. Krauss on Molokai and Maui.

Psocids on stored dog food—Mr. Krauss reported that many specimens of *Deipnopsocus* sp. and a few of *Liposcelis divinatorius* (Mull.) were collected on a commercial dry dog food made of cereal, meat, fish meal, etc., in Honolulu on January 18, 1943. The dog food had been stored for some time. Determinations were

made by Mr. H. K. Townes through the U.S. Bureau of Entomology and Plant Quarantine.

Orthezia insignis Douglas—Mr. Pemberton reported receiving a branch of pamakani (*Eupatorium glandulosum* H.B.K.) collected in Honalua gulch, Maui, at 2,000 feet elevation by F. W. Broadbent, which was heavily infested with this coccid. Though this insect has been known in Hawaii since 1899, this is apparently the first record of its occurrence on pamakani in the Islands. Mr. H. T. Osborn in 1924 recorded noticeable injury to pamakani by an *Orthezia* at Cuernavaca, Mexico.

Biological control of *Pseudococcus brevipes* (Ckll.)—Dr. Carter presented the following: The abandonment of ratoon pineapple fields due to labor shortages has resulted in many areas where mealybug populations on the developing ratoon fruit have reached a considerable size. At the same time the fields have become very weedy. Under these circumstances, biological control of *P. brevipes* has been sufficient to almost completely eliminate the insect from the fruit. The principal factor operating is undoubtedly *Lobodiplosis pseudococci* Felt, the predaceous midge collected in Mexico by Mr. Fullaway. Many fruits can be found plastered with the old webs of this insect, with no mealybugs left alive on the fruits.

With such control evident, it is interesting to speculate on why biological control of the mealybug is not more generally successful. First among the possible reasons is the establishment of large populations on fruit. The midge is rarely found on leaves, possibly because the mealybugs on leaves keep moving down into the dark center of the plant, as the leaves grow. On the other hand, mealybugs on the bases of fruits are more sessile and give opportunity for the midge to establish its web over the developing female mealybug. Second is the fact that in a weedy field, *Pheidole* ants are apparently more independent of mealybugs for food, and their attendance on the mealybug is not as close as normally.

Unfortunately, even in these fields where the mealybugs on fruit are practically wiped out, residues of the populations are to be found on all the developing suckers in the vicinity of the infested fruits. These colonies are untouched by the midge, and it is these colonies which will cause mealybug wilt in the developing suckers. It is clear that no biological factor can operate to prevent mealybug wilt unless it is capable of reducing populations of mealybugs on young, unfruited plants, well attended by ants.

Egg parasite of *Pycnoderes*—Mr. Fullaway recorded the establishment here of a new species of *Anagrus*,* a parasite of the egg of *Pycnoderes quadrimaculatus* (Guerin), recently imported from Sinaloa, Mexico.

* *Anagrus yawi* Fullaway; see p. 57.

Bufo marinus (Linn.)—Dr. Williams spoke of the homing faculty of the giant toad, *Bufo marinus*. This summer adult males were marked by cutting off the tips of certain toes, and brought from a small lily pond on upper Keeaumoku Street to the H.S.P.A. Experiment Station on the same street, a distance of about 2300 feet. One *Bufo*, blind in one eye, that had previously returned, was back the second time in 29 days. Of four other normal males, a large specimen carried in a sack to the Experiment Station was back to the lily pond within six days, the other three not having appeared to date. At present, and for some time, there has been a great preponderance of males in this lily pond.

AUGUST 9, 1943

The 452nd meeting was held at the H.S.P.A. Experiment Station on Monday, August 9, at 2:00 p.m., with President Holdaway in the chair.

Members present: Messrs. Bianchi, Fullaway, Holdaway, Krauss, Look, Marlowe, McBride, Nishida, Pemberton, Rosa, Sakimura, Schmidt, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

Visitor: Ensign H. E. Graham, U.S.N.

PAPER

Mr. Swezey presented a paper entitled: "Keys to Some Lepidopterous Larvae Found in Gardens and Homes in Hawaii."

NOTES AND EXHIBITIONS

Uloborus geniculatus (Olivier)—Mr. Swezey exhibited this interesting spider, the name of which he found in "The Spider Book" by Comtock (Gertsch revision; p. 267, 1940). It is a tropical species of both hemispheres. It has made its appearance somewhat recently in Hawaii. It was especially abundant in his basement, with numerous webs in all possible positions. The earliest dated specimen in the H.S.P.A. collection is 1927.

Trichogramma minutum Riley—Mr. Swezey exhibited a slide mount of this parasite reared from an egg of *Heliothis armigera* (Hübner) on a tomato leaf, Honolulu, July 29, 1943. This is perhaps the first record of rearing this parasite from *Heliothis* in Hawaii.

Lasioderma serricorne (Fabr.)—Mr. Swezey reported having counted 1227 of the cigarette beetle in a small container of dried herbs, which had been entirely consumed, leaving a layer of fine black frass at the bottom. All stages were found: adults, pupae and larvae, and there were eggs amongst the frass. The eggs were not counted.

Telenomus rhopali Perkins — Mr. Swezey exhibited a slide mount of this scelionid, eight of which had issued from a cluster of 19 eggs of *Corizus hyalinus* (Fabr.) on a flower bud of *Sonchus oleraceus* Linn. collected by the roadside on Manoa hill above Punahou School grounds in June 1943. This is a parasitism of 42 per cent.

Pleistodontes imperialis Saunders—Mr. Pemberton reported the rearing of quantities of this caprifying fig wasp (family Agaonidae) from fruits of *Ficus eugenioides* F. v. Mueller, collected in upper Manoa Valley, Honolulu on August 4 by E. L. Caum. This is of interest since the insect is the normal caprifier, or pollinator, of *Ficus rubiginosa* Desfontaines, and was introduced into Hawaii in 1921 to induce the production of viable seed of this tree. The close similarity of *F. eugenioides* and *rubiginosa* suggests that one is merely a variety of the other, in view of the present breeding record.

Murgantia histrionica (Hahn)—Mr. McBride spoke of the presence, in all stages, of the harlequin cabbage bug in Victory gardens in Kalihi, Honolulu, on broccoli.

New host of Mediterranean fruit fly—Mr. McBride recorded the balsam apple (*Momordica balsamina* Linn.) as a new host for *Ceratitis capitata* (Wiedemann).

An aphid new to Hawaii—Mr. Zimmerman reported collecting *Aphis ferruginea-striata* Essig on carrot at Wilhelmina Rise, Honolulu, August 13, 1942. The material was identified by Prof. E. O. Essig. This California species, which occurs on celery also, has not been recorded heretofore from the Hawaiian Islands. It was described in Hilgardia (**9** (9) : 464, fig. 3, 1938).

Parasites of tomato pin worm—Mr. Fullaway exhibited two new Braconidae reared from *Keiferia lycopersicella* (Busck), the tomato pin worm. One is a species of *Apanteles*, the other, an undetermined genus, new to the Territory. They were secured in June 1943 by Messrs. Swezey, Fullaway and others.*

Two aphids new to the Hawaiian Islands—Mr. Krauss presented the following notes on two aphid species not previously known from Hawaii, both determined by Prof. E. O. Essig: *Aphis tavaresi* Del Guercio, collected at Wailuku, Maui, June 6, 1943; this species occurs on *Citrus* in Japan, Australia and South Africa. Specimens of *Neophyllaphis araucariae* Takahashi were taken on leaves of Norfolk Island pine (*Araucaria excelsa* R. Brown) near the edge of Waikolu Valley, Molokai, June 3, 1943, and on the same host plant at Hana, Maui, June 30. This is the same aphid collected by Timberlake on *Araucaria* in Kapiolani Park, Honolulu, January 30, 1916 (Proc. Haw. Ent. Soc., 3(4) : 267, 1917). The species was described by Takahashi (Proc. Roy. Ent. Soc. London

* See p. 22.

(B) 6: 105, fig., 1937) from specimens collected in Mauritius on *Araucaria cunninghamii* Aiton.

Graptostethus nigriceps Stål—Mr. Nishida reported taking this lygaeid bug on eggplant at the Kaimuki Victory garden, July 23, 1943. This species was first taken by Mr. Sakimura in the Kunia district, Oahu, July 21, 1942.

Mr. Zimmerman reviewed the publication by J. T. Patterson et al. entitled: "Studies in the Genetics of Drosophila III. The Drosophilidae of the Southwest." (The University of Texas Publication **4313,** 327 pp., ill., 1943). The following Drosophilidae which occur in Hawaii are illustrated in full color in this excellent volume: *Chymomyza procnemis* (Williston), *Drosophila ananassae* Doleschall, *D. mercatorum* Patterson & Wheeler, *D. melanogaster* Meigen and *D. hydei* Sturtevant.

SEPTEMBER 13, 1943

The 453rd meeting was held at the H.S.P.A. Experiment Station on Monday, September 13, at 2: 00 p.m., with President Holdaway in the chair.

Members present: Messrs. Fullaway, Goolsby, Holdaway, Krauss, Look, Marlowe, Pemberton, Sakimura, Schmidt, Swezey, Tanada, Usinger, Williams and Zimmerman.

Visitor: T. C. Russell.

PAPERS

Mr. Zimmerman, on behalf of Dr. R. A. Cushman, presented a paper entitled: "The Hawaiian Species of Enicospilus and Abanchogastra (Hymenoptera: Ichneumonidae)". Mr. Zimmerman also presented his own paper: "A Case of Bovine Auricular Myiasis and Some Ectoparasites New to Hawaii".

NOTES AND EXHIBITIONS

Argiope avara Thorell—Mr. Swezey reported seeing a female of this spider on a web with two egg cocoons hanging to the electric wire near his place on Lanihuli Drive, Manoa. The spider has been scarce of late years on account of the ichneumonid, *Tromatobia rufipectus* (Cresson), feeding on its eggs.

Cremastobombycia lantanella Busck—Mr. Swezey reported having examined 110 mines of this moth in lantana leaves, August 23, 1943, in which 95 per cent of the larvae had been destroyed by parasites. Only three moth larvae were found, and two cocoons. A moth issued from one cocoon, and the eulophid parasite, (*Pseudopheliminus vagans* Timberlake), from the other, September 1.

Ampulex compressa (Fabr.)—Mr. Swezey reported some interesting observations on the New Caledonia cockroach wasp, made in the basement of his house. In one instance a female wasp was observed to enter a crack to an incompletely closed drawer to the workbench, and very quickly emerged again; then in a few moments returned with small bits of shavings in her mandibles. She was watched as she repeated this procedure half a dozen times in ten minutes. Then, on opening the drawer, an Australian cockroach was found behind an object in a corner of the drawer, where the wasp had attempted to enclose it by bits of shavings. An egg was found on the roach, which was then placed in a vial for the development of the parasite. The adult wasp issued in about six weeks. In another instance, an Australian cockroach was found in a small pasteboard carton among a pile of cartons. The roach seemed sluggish, and on examination was found to harbor a wasp larva on the ventral side of the thorax. The carton contained a mass of shredded paper used in packing. There was enough of a gap at one corner of the cover so that a wasp could enter, and it is inferred that she had found the roach already inside, and paralyzed it and oviposited on it right there, rather than dragged it in for seclusion.

Truck garden pests—Mr. Fullaway exhibited specimens of the onion leaf miner, *Acrolepia assectella* (Zeller), a plutellid moth new to the Territory. It was found in all the valleys back of Honolulu, as well as at Kailua, Oahu. Mr. Fullaway reported mites bad on Irish potatoes and yams, while the Mexican mealybug (*Phenacoccus gossypii* Towns. & Ckll.) was in heavy concentration on such crops as lima beans and eggplant.

Acrolepia assectella (Zeller)—Dr. Holdaway exhibited two cocoons of this onion moth collected by Walter Furuya in April 1939 on onion. Although the place record appears on the specimens as University campus, the material was probably collected at Kalihi, where Mr. Furuya had an experimental plat in which onions were being grown. This insect, identified by Mr. Swezey, has recently been the subject of study by Mr. Fullaway who found it on green bunching onions in Manoa Valley and other places in, or near, Honolulu. The specimens had been awaiting identification for some time and had remained unidentified until additional material was collected recently. The insect is recorded as a pest of onion and leek in Europe (Denmark, Germany and Russia). To date it appears not to be widespread in Hawaii, for Dr. Holdaway, who has just returned from a visit to Maui and Hawaii, stated that he had seen no evidence of it in the onion fields and plats he examined on those islands. However, except for the possible exception of one or two fields in Manoa, it does not seem to be serious yet.

Tiphia segregata Crawford—Mr. Sakimura reported that in the Kunia section of Oahu this parasite has been observed flying in

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Acrolepia assectella (Zeller)—Dr. Holdaway exhibited two cocoons of this onion moth collected by Walter Furuya in April 1939 on onion. Although the place record appears on the specimens as University campus, the material was probably collected at Kalihi, where Mr. Furuya had an experimental plat in which onions were being grown. This insect, identified by Mr. Swezey, has recently been the subject of study by Mr. Fullaway who found it on green bunching onions in Manoa Valley and other places in, or near, Honolulu. The specimens had been awaiting identification for some time and had remained unidentified until additional material was collected recently. The insect is recorded as a pest of onion and leek in Europe (Denmark, Germany and Russia). To date it appears not to be widespread in Hawaii, for Dr. Holdaway, who has just returned from a visit to Maui and Hawaii, stated that he had seen no evidence of it in the onion fields and plats he examined on those islands. However, except for the possible exception of one or two fields in Manoa, it does not seem to be serious yet.

Tiphia segregata Crawford—Mr. Sakimura reported that in the Kunia section of Oahu this parasite has been observed flying in

fairly large numbers among the wild growth immediately outside pineapple fields. Parasitized *Anomala* grubs have been found in pineapple fields, although a very small number of pupal shells were found there. The first case of parasitized *Anomala* was recently found (August 1943) among a lot of grubs dug from a Waipio pineapple field. Of 382 grubs, 25 (6.3 per cent) were parasitized. There was no parasitism by *Campsomeris marginella modesta* Smith among this material. These data show that *Tiphia* may operate in large numbers on *Anomala* grubs in pineapple fields under certain conditions.

Graptostethus nigriceps Stål—Mr. Sakimura said that general populations of this recently found lygaeid bug seem to have increased somewhat this season. During the summer of 1942 two individuals were caught in the wind traps at Kunia, while up to the present time this year more than 20 have been taken. Large numbers of the adults were observed feeding in the flowers of sweet potato and wild morning-glory in Kunia.

Stictocephala festina (Say)—Mr. Sakimura reported a very heavy infestation of this membracid on bush beans, which were badly damaged in a home garden under his observation. The insect showed a specific preference for this host; no other plants were attacked.

Alphitobius diaperinus (Panzer)—Mr. Zimmerman reported rearing this tenebrionid beetle from larvae found abundantly in the nests of English sparrows in Honolulu.

New cockroach egg parasite from Honolulu—Mr. Zimmerman presented the following: For a period of about two years I have had under observation the pretty little chalcid wasp recorded as a new immigrant *Metaphycus* by Mr. Pemberton (Proc. Haw. Ent. Soc., **11** (2) : 139, 1942). I have found this parasite common over most parts of Honolulu, and had assumed from its habits that it was probably a cockroach parasite, in spite of the scale-infesting habits of its well known relative, *Metaphycus lounsburyi* (Howard). It is now possible to report that this elegant newcomer is an effective parasite of the oöthecae of the commonest household cockroach in Honolulu, *Supella supellectilium* (Serville). I have reared as many as 20-odd parasites from a single oötheca, and, at least in one locality, have found the rate of parasitism to be almost, or 100 per cent of, all oöthecae found. It is not known whether or not the parasite is host specific, but studies on the wasp are continuing, and further details as to its identity and habits will be forthcoming.

Solenopsis geminata rufa Jerdon—Mr. Pemberton reported this ant as killing tomato plants at Waialua, Oahu, by eating holes in the stems, chiefly underground.

OCTOBER 11, 1943

The 454th meeting was held at the H.S.P.A. Experiment Station on Monday, October 11, at 2:00 p.m., with President Holdaway in the chair.

Members present: Messrs. Bianchi, Faxon, Fullaway, Holdaway, Hyslop, Look, Marlowe, Nishida, Pemberton, Rosa, Sakimura, Swezey, Usinger, Van Zwaluwenburg, Williams and Zimmerman.

Visitors: T. C. Russell and Capt. Franklin Sherman III.

PAPER

Mr. Swezey presented a paper entitled: "Notes on Zaischnopsis sp., an Egg-parasite of Holochlora japonica in Hawaii".

NOTES AND EXHIBITIONS

Scholastes bimaculatus Hendel—Mr. Swezey exhibited a large coconut which had been found to have hundreds of maggots of this ortalid fly in the husk, from the beach at Niu, Oahu, September 26, 1943. The nut had been caught in a barbed wire entanglement where, splashed by the waves, the husk had been softened and a good deal of its outer surface torn off. Maggots were somewhat yellowish in color when small, turning bluish when about full grown. They apparently fed on the moistened soft material between the fibers of the husk. There was no evidence of rotting. Maggots formed puparia in situ, though the nut was placed over sand in a jar, presuming that the maggots would issue and pupate in the sand.

Later note by Mr. Swezey: Later on, many maggots did issue from the husk and formed puparia in the sand beneath the coconut. Adult *Scholastes* began to issue on October 8 and records were kept daily. The bulk of them issued between October 20 and November 20, but there were a few scattering issues up to December 11. The total count was 1380, of which 42 per cent were females and 58 per cent males. They were constant in wing pattern, there being no variation that could approach a single unidentified specimen in the H.S.P.A. collection, collected in 1905, which differs from other specimens by having two distinct dark bars across the wings. It seems evident that this must be another species.

Prohippelates pallidus (Loew)—Mr. Swezey reported that this chloropid fly issued from the above coconut even more abundantly at first than *Scholastes* did.

Synonymy of two Hawaiian moths—Mr. Swezey called to attention that Corbett and Tams (The Entomologist, **76**: 15, 1943) state that *Ephestia kuehniella* Zeller is a synonym of *Ephestia sericaria* (Scott), and that *Endrosis lactella* (Schiffermüller) is a synonym of *Endrosis sarcitrella* (Linn.).

Hawaiiana wilsoni (Rothschild)—Mr. Swezey called attention to the recent discovery in the literature, of a new genus, *Hawaiiana*, erected by Tutt (The Ent. Record and Journ. of Variation, **15**:76, 1903). The genus was made for the Hawaiian Sphingidae which were described under *Deilephila* and later placed by Rothschild and Jordan in *Celerio*. Two species were known at the time: *wilsoni* and *calida* (Butler); a third species, *Celerio perkinsi* Swezey, was described later.

Acrolepia assectella (Zeller)—Mr. Swezey reported that he had received word from Dr. Muesebeck that Mr. Heinrich had confirmed the determination of the plutellid onion moth which was recently found attacking onion crops in Manoa Valley, as the above species. It is an onion pest in Europe, and also feeds on garlic, leeks and chives.

Eumerus marginatus Grimshaw and *E. aurifrons* (Wiedemann)—Mr. Swezey reported rearing these syrphid flies from maggots found in cassava root (*Manihot utilissima* Pohl) from Kailua, Oahu, July 21, 1943. Apparently the infestation had begun in a diseased portion of the root, and had worked on into the sound portion, causing it to rot. The first two flies to mature were *E. aurifrons*, appearing August 2 and 16. Most of the maggots were of the larger species, *E. marginatus*. They were full grown by September 10, and the flies matured before September 28. Fourteen issued and died before being noticed, as the tin they were in was not examined for several days.

Parasites of tomato pin worm—Mr. Fullaway reported that the parasites bred from *Keiferia lycopersicella* (Busck) had been identified by Dr. Muesebeck as *Hormius pallidipes* Ashmead* and *Apanteles dignus* Muesebeck,** both species being new records for Hawaii. Mr. Look reported that *Hormius* was first collected on October 10, 1942 at Waimanalo, Oahu, and later at Lualualei, Oahu on June 25, 1942. He stated that a third parasite reared from tomato pin worm has been identified by Dr. Muesebeck as *Chelonus blackburni* Cameron.

Micromyzus formosanus (Takahashi) on Maui—Mr. Fullaway reported finding the onion aphis at Olinda, Maui; this is a new island record for this species.

Megachile gentilis Cresson—Mr. Van Zwaluwenburg reported finding cells of this common megachilid bee under odd circumstances. Within an onion leaf which had been perforated by either a *Heliothis* or a *Lathygma exigua* (Hübner) larva, four cells of the bee were found on August 17 at Waipio substation. The leaf material from which the cells were made was not identified. The first bee emerged September 23-24. This species is better known

* Described from Maryland in Trans. Amer. Ent. Soc., **20**: 42, 1893.
** Described from California in Proc. Ent. Soc. Washington, **40**(7): 203, 1938.

locally as *Megachile palmarum* Perkins, a synonym. The identification was made by Dr. Williams.

Corizus hyalinus (Fabr.)—Mr. Van Zwaluwenburg presented the following notes on this coreid bug: Nymphs and adults were confined in large glass tubes and each day given fresh pieces of *Sonchus oleraceus* Linn., bearing blossoms or buds, on which they fed readily. When *Emilia sonchifolia* De Candolle or *Euphorbia* spp. were substituted, no feeding on these plants was observed. Egg-laying was confined mainly to the buds, but sometimes occurred on the petioles. The eggs, attached by a very short pedicel, were laid in clusters of from one to 18, with an average of 4.4 eggs per cluster. All eggs, without exception, hatched.

The egg stage required about 125 hours at an average mean temperature of 78.2 degrees Fahrenheit. The five instars from hatching to adult required a total of 15 to 16 days. Oviposition first took place between 72 and 78 hours after attaining the adult stage. One laboratory-bred female lived 35 days in captivity, and, ovipositing on each of 32 consecutive days, laid a total of 387 eggs (averaging 12 eggs per day of laying). A field-collected female lived 27 days in captivity (then escaped) and laid 350 eggs; she failed to produce even one egg on only three days of the entire period. A field-collected male survived for 41 days. Laboratory-bred females mated when three days old (at which time males first became available) and continued to mate daily until within a day of death.

Dr. P. A. Readio (Ann. Ent. Soc. America, 21: 187-201, 1928) working in Kansas with this species, reared it readily on *Lactuca scariola* Linn. Temperatures during this period were somewhat higher than those during observations in Honolulu, reaching the nineties and upper eighties at mid-day, whereas here they seldom exceeded 85 degrees Fahrenheit. Comparisons between Readio's results and those obtained here are interesting:

	Kansas	Honolulu
Preoviposition period	3-4 days	3 + days
Egg stage	6-7 "	5.2 "
Hatching to adult	9-11 "	15-16 "
Adult to adult	17*"	23-24 "

The maximum survival of laboratory-bred females recorded by Readio was 50 days, with a maximum of 558 eggs laid.

Apanteles marginiventris (Cresson)—Mr. Pemberton reported finding a cocoon of this armyworm parasite on a blade of grass at Wailua, Kauai on September 23, 1943. The cocoon later produced a normal female. This is the first evidence of the establishment of this braconid on the island of Kauai, where liberations were made during January and February 1943. The recovery was made at

* Minimum.

least a mile from any point where liberations were made. The parasite was introduced into Hawaii from Brownsville, Texas, by F. A. Bianchi during 1942-43.

Mosquitoes developing in brackish water—Mr. Pemberton mentioned receiving about two gallons of water taken from wells in the coral plain at Ewa, Oahu, by Capt. Franklin Sherman III, which contained large numbers of larvae of *Culex quinquefasciatus* Say, as well as many of *Aedes albopictus* (Skuse). Analysis of this water by the chemistry department, Experiment Station, H.S.P.A., showed a salt concentration (mostly sodium chloride) of 2992 mg. per liter. All stages of larvae were present, together with pupae. Normal appearing adults began hatching within 24 hours.

Mites and thrips on asparagus—Severe injury, probably by the common red spider and *Thrips tabaci* Lindeman, was reported by Mr. Sakimura on a large commercial planting of asparagus at Waipahu. Many brown areas were scattered among the older plantings, and populations of both mites and thrips were extremely high there. Two predaceous thrips, *Aelothrips fasciatus* (Linn.) and *Scolothrips sexmaculatus* (Pergande), were vigorously preying upon them, and the former species especially, was unusually abundant. This is the first record of *A. fasciatus* on Oahu. The common *Frankliniella* sp. was also present on the plants, but was not noticeably abundant.

Hercothrips fasciatus (Pergande)—Mr. Sakimura reported that this notorious thrips was not found among Kauai material collected by Mr. Nishida during August. A special effort was made to detect this species at various localities, but it could not be found. This thrips was also absent from an extensive, systematic collection, still in progress, made on the leeward side of Oahu, especially at Waipahu, Manoa and Waialae. This species therefore does not seem to have become established as yet on Kauai or Oahu.

NOVEMBER 8, 1943

The 455th meeting was held at the H.S.P.A. Experiment Station on Monday, November 8, at 2:00 p.m., with Vice-president Fullaway in the chair.

Members present: Messrs. Bianchi, Fullaway, Krauss, Look, Nishida, Pemberton, Rosa, Sakimura, Schmidt, Swezey, Van Zwaluwenburg and Zimmerman.

Visitors: Ensigns Harry P. Chandler and H. E. Graham; T. C. Russell, and Capt. Franklin Sherman III.

The name of Mr. Kenneth Murakami was proposed for membership in the Society.

PAPERS

The following papers were presented: "Thrips from Maui and Molokai", by Messrs. Sakimura and Krauss; "Heteroptera of Can-

ton Island", by Dr. Usinger; and "Description of a New Mymarid Egg Parasite Collected at Los Mochis, Sinaloa, Mexico", by Mr. Fullaway.

NOTES AND EXHIBITIONS

Apanteles marginiventris (Cresson)—Mr. Pemberton reported on the spread of this armyworm parasite on the island of Kauai. On November 4 he found, without difficulty, cocoons of this parasite attached to grass at Kilauea Plantation Company, and reared the adult from one of the cocoons the following day. By direct line this is about 20 miles from any point on the island where liberations were made eight months previously. A cocoon of this parasite was also found on a grass blade at Olokele Sugar Company on November 5, which was approximately 25 miles from the nearest point of liberation. The spread of this braconid is of exceptional interest because of the great scarcity of its host during the entire period since the original liberations were made.

Mosquitoes on inter-island planes—Mr. Pemberton commented on the ineffectiveness of control methods adopted by the Hawaiian Airlines Ltd., in the prevention of mosquitoes moving from Oahu to other islands on their passenger airplanes. On three trips which he made during October and November, living mosquitoes were captured by him on planes while in flight, from 10 to 20 minutes after the planes had been sprayed with the widely-used "aerosol bomb". The spray is pyrethrum extract suspended in "freon" gas. It appeared that the failure to kill resulted from an insufficient liberation of gas or spray. Operators in each case allowed the gas to escape for only seven seconds at most. All living mosquitoes caught were *Culex quinquefasciatus* Say.

Technomyrmex albipes (F. Smith)—Mr. Pemberton discussed the prevalence of colonies of this ant in tightly curled leaves of the litchi tree (*Litchi chinensis* Sonn.) at Waiakea, Hawaii, which he found on October 20. In each case the occupied leaves were heavily infested with the litchi mite, *Eriophyes litchii* Keifer,* and curled and deformed through this infestation. Entire colonies of the ant occurred in the leaves.

Cardiocondyla emeryi Forel—Mr. Swezey reported having a recent letter from Dr. M. R. Smith of the U.S. National Museum, in which he had determined as *emeryi* some specimens among other specimens of *Cardiocondyla* which had been sent him for study. In fact, there were more of this species in the lot than there were of the other species of *Cardiocondyla* known here. Apparently *emeryi* has been in Hawaii for some time; however, when Dr. Wheeler looked over ant collections here in 1930, he did not note any specimens of *emeryi*.

* Described in "Eriophyid Studies XIII", Bull. Cal. Dept. Agr., 32(3): 212, pl. 171, July-Sept. 1943. This species was until now apparently misidentified under the name *Eriophyes chinensis* Trotter (Bull. Soc. ent. France, 1900: 180).

Iridomyrmex humilis Mayr—Mr. Fullaway said that the area now occupied by the Argentine ant measured about one-quarter by one-half mile, and was still confined to the military reservation on which it was first found here in 1940.

Taeniothrips xanthius (Williams)—Mr. Sakimura reported that this thrips was recently found to be breeding freely on leaves of *Asystasia gangetica* (Linn.) (family Acanthaceae) growing under benches of an orchid house in Manoa. Orchids, especially *Cypripedium,* in this house have been seriously injured. Contact sprays consisting of nicotine sulfate and "loro" have been used, but thrips persisted in spite of spraying. It is now evident that persistence was due to the presence within the orchid house of an alternative host plant. Keeping orchid houses free from *Asystasia* is evidently necessary for control of this thrips, which is one of the most injurious insect pests of orchids in Hawaii. Careful search on various weeds within the orchid house, and also on *Asystasia* growing immediately outside, did not reveal the presence of this thrips. It also failed to establish itself on several other species of plants under experimental conditions. Its extremely narrow host range indicates that dissemination from one orchid house to another occurs when orchid plants are transferred, but for survival within the house it probably depends on *Asystasia* in addition to orchids. This thrips has been known to be very injurious in the West Indies, eastern United States and Brazil, but no alternative host has been recorded, and it has been thought to be a specific feeder on orchids. It was once collected from insect galls on a plant other than orchids in Florida. This thrips has been known in Hawaii since 1935.

Cryptoblabes aliena Swezey—Mr. Krauss reported that larvae of this phycitid moth were found feeding on berries of the Christmas berry tree, *Schinus terebinthifolius* Raddi, in Manoa Valley, Honolulu, during September. The insect was causing an unsightly webbing in the clusters of ornamental berries.

Latrodectus mactans var. *hesperus* Chamberlin & Ivie—Mr. Krauss reported that specimens of this variety of the black widow spider were collected in south central Molokai on May 31, 1943. This variety is the one found in California and other western states. *Latrodectus geometricus* Koch was taken in the same area on the same date. The specimens were determined by Prof. R. V. Chamberlin.

Thecla echion (Linn.)—Mr. Bianchi exhibited two small chili peppers which had been thoroughly destroyed in a Honolulu garden by caterpillars of this species, which were now in the pupal stage. This provides a new host record for the caterpillar, which has previously been reported from eggplant and other solanaceous plants, but not from pepper.

DECEMBER 13, 1943

The 456th meeting was held at the H.S.P.A. Experiment Station on Monday, December 13, at 2:00 p.m., with President Holdaway in the chair.

Members present: Messrs. Bianchi, Carter, Faxon, Fullaway, Holdaway, Ito, Krauss, Look, Marlowe, McBride, McPhail, Nishida, Pemberton, Sakimura, Schmidt, Swezey, Tanada, Van Zwaluwenburg, Williams and Zimmerman.

Visitors: Wm. Craft, S. S. Ristich and T. C. Russell.

Mr. Kenneth Murakami was elected to membership; Mr. Zimmerman proposed the name of Mr. Wm. Craft for membership in the Society. On motion of Dr. Schmidt it was unanimously voted to instruct the Secretary to send a letter of thanks to the Hawaiian Sugar Planters' Association for financing the publication of the Society's Proceedings for 1942.

This being the annual meeting, a slate of officers to serve during the coming year was presented by the executive committee. There being no nominations from the floor, the slate was accepted and the following officers unanimously elected:

President.....Richard Faxon
Vice president.....N. L. H. Krauss
Secretary-treasurer.....Dr. F. X. Williams
Additional members of executive committee.....
.....M. McPhail and Dr. C. T. Schmidt

PAPERS

The following papers were presented: "Notes on Insects and Other Arthropods from the Islands of Molokai and Maui, Hawaii", by Mr. Krauss; "Thrips from Kauai", by K. Sakimura and T. Nishida; "Nesothrips Kirkaldy Supersedes Oedemothrips Bagnall", by Mr. Bianchi; and "Biological Studies in Hawaiian Water-loving Insects, Parts III D, IV and V", by Dr. Williams. Mr. Zimmerman presented two papers entitled: "Pembertonia, a New Genus of Papuan Cossoninae (Coleoptera, Curculionidae)" and "Two New Amblycnemus from Larat Island (Coleoptera, Curculionidae)".

NOTES AND EXHIBITIONS

Zaischnopsis sp.—Mr. Swezey reported having reared 13 of these parasites from an egg cluster of *Holochlora japonica* (Brunner) eggs in an hibiscus twig collected in his garden on Lanihuli Drive, October 12, 1943. The parasites issued one to three per day over a period of 40 days from Oct. 18 to Nov. 29.

Ephestia sericaria (Scott)—Mr. Swezey exhibited a specimen of the Mediterranean flour moth which he had reared from a pecan nut December 13, 1943. An occasional infested nut was found in a pound of nuts obtained at a local fruit store. In each case, the nut was somewhat cracked allowing for the entrance of the small larva.

Eucelatoria armigera (Coq.)—Mr. Pemberton, commenting on Mr. Krauss' finding of this tachinid fly at Olinda, Maui on June 12 (see p. 89), spoke of the importance of this recovery and stated that adults of the fly were reared at the H.S.P.A. Experiment Station by Mr. Van Zwaluwenburg, and sent to Puunene, Maui on February 28 and March 8, 1943. These were liberated at Hawaiian Commercial and Sugar Company, Ltd. Since this conspicuous fly has never been previously collected on Maui, it is probable that its establishment on that island is the result of the introduction early this year.

Eriosoma lanigerum (Hausmann)—Mr. Look exhibited specimens of an aphid, apparently the wooly apple aphid. They were collected alive from a green apple (Newtown pippin) on November 22, 1943. Fifteen apterous adults and nymphs were found breeding in the core. No alates were present. The apple, which was imported apparently from the west coast, was bought in the local market in November. Mr. Pemberton stated that during a visit to Keanakolu, Hawaii, on October 27, 1943, he observed an abundance of this aphid on old apple trees. This is at an elevation of about 4500 feet. Mr. Fullaway remarked that this aphid has long been known in Hawaii on apple trees.

Some new host records—Mr. Nishida reported the following instances of new food plant records: On May 9, 1943 loopers were collected from lettuce seedlings grown in the Hawaii Experiment Station greenhouse. Upon rearing, it was found that these were *Autographa brassicae* (Riley) instead of *Plusia chalcites* (Esper). This is of interest because *A. brassicae* is commonly associated with cabbage, or plants closely related to it.

On September 1, 1943 *Conocephalus saltator* (Saussure) was observed on green beans at Waimea, Kauai. Several of these grasshoppers were observed feeding on the blossoms. It was not possible to ascertain whether the feeding had any detrimental effect on the yield, because it appeared that the grasshoppers fed primarily on the corolla; the pistils and stamens were apparently uninjured. On December 1, 1943, a heavy infestation of *Coccus viridis* (Green) was observed in a small celery patch on South Street, Honolulu. The scales were observed on both the petiole and leaf.

President Holdaway then delivered his presidential address entitled: "Insects of Vegetable Crops in Hawaii Today". His introductory remarks were as follow:

The meeting today—the 456th meeting of the Entomological Society—is the 38th annual meeting. I am very conscious of the honor bestowed on me by the Society in asking me to be its President during the past year, an honor which is greater because of the upheaval in world affairs through which we are passing and the important part that our science is playing in helping the survival of this nation and her allies.

In spite of the war our Society has continued to meet regularly as in the past; not a single meeting has been missed. Because of this the Society holds a unique place among the scientific bodies of the Territory. Moreover, attendance at meetings has been maintained at a high level, and many valuable observations and contributions have been made available for the mutual benefit of ourselves and our fellow workers elsewhere.

We have been pleased to welcome several visiting entomologists and others interested in entomology at our meetings. While the war has brought in its train certain restrictions of personal liberties, it has also brought to our midst many entomological workers whom we have been pleased to have with us.

In recent years many insects not formerly present in the Territory have been discovered here and some, formerly of insignificance, have become important. The list of common names proposed by the Society in 1913 has thus been inadequate for the needs of entomological workers and agriculturists of today. In 1939 the Society appointed a committee consisting of D. T. Fullaway, F. G. Holdaway, O. H. Swezey and E. C. Zimmerman to compile a new list of common names adequate to the needs of the day, and, in the light of present knowledge, accurate as regards technical names. The committee had brought its studies to an advanced stage when the war hit us, and active work on the list had to be discontinued for a time. The need for public and popular dissemination of information on insects has, however, become even more necessary than in the past. In March 1943 the committee made its tentative list available in mimeographed form to entomological workers and other interested persons. Throughout the year the committee has continued to work on the list, revising, correcting and adding. Almost every technical name, authority and common name has been the subject of special and detailed study. The committee has appreciated the assistance given by several members of the Society who have contributed their time and specialized experience towards making the list as complete and accurate as possible in the light of present knowledge. The list, which now contains 330 names, is ready for final approval by the Society. I hope that the incoming executive committee will see its way clear to publishing the list in three different arrangements, with the common name first, with the technical name first, and according to orders.

Nesothrips Kirkaldy Supersedes Oedemothrips Bagnall

BY FRED A. BIANCHI

Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of December 13, 1943)

In 1907, three years previous to the appearance of Bagnall's monograph of the Thysanoptera of the Hawaiian Islands, (Fauna Hawaiiensis, 3 (6) : 669-704, 1910) G. W. Kirkaldy erected the genera *Agnostochthona* and *Nesothrips,* each represented by a single species. The descriptions appeared together ("On Two Hawaiian Thysanoptera", G. W. Kirkaldy, Proc. Haw. Ent. Soc., 1 : 102) and constituted the first published reference to the Thysanoptera of these islands. They were later incorporated in Bagnall's monograph, but it was therein stated in the case of *Agnostochthona,* and implied in the case of *Nesothrips,* that Bagnall had not examined the type material on which the genera were founded. It was also indicated, at least by implication, that to Bagnall neither of the descriptions seemed adequate. How just that indication may have been in regard to *Agnostochthona* may never be ascertained, as Kirkaldy failed to state the disposition of his type material and with his passing it was lost to science. In regard to *Nesothrips,* the writer is now able to establish beyond question that Bagnall's distrust of Kirkaldy's description was entirely justified.

After being lost for many years the types of *Nesothrips* have again come to light. Some time before his death, the late E. M. Ehrhorn had informed the writer that years earlier he had mounted Kirkaldy's originally pinned specimens intending to study them, but that he had later misplaced the slide and had been unable to find it again; and now that slide, fully and plainly labelled, has been found. It was one of an accumulation of old slides which the courtesy of Noel Krauss of the Territorial Plant Quarantine Station has enabled the writer to examine. Consisting of a balsam mount of two specimens under the same cover, it is sufficiently clear to permit unmistakable identification of the specimens as a male and a female of the species which Bagnall (Fauna Haw., 3 (6) : 680) called *Oedemothrips laticeps* and upon which he erected the genus of the same name. Therefore, unjust as it must seem to anyone even carelessly glancing over Kirkaldy's description, the rules of taxonomy now demand the following revision:

Oedemothrips Bagnall 1910, becomes *Nesothrips* Kirkaldy, 1907.

Oedemothrips laticeps Bagnall 1910 becomes *Nesothrips hawaiiensis* Kirkaldy 1907.

The genus *Oedemothrips* or, by its new name, *Nesothrips,* is represented in our Territory only by the type species, and elsewhere only by the species *brevicollis* Bagnall in Japan, *propinquus* Bagnall in Australia, *propinquus* var. *brevipes* Bagnall in New Zealand, and *ceylonicus* Karny in Ceylon. Although not a genus of economic significance, the wide geographical distribution of its few species makes it one of interest. It does not seem superfluous, therefore, to present here a fuller description of the type species than has yet been accorded any of the others.

1907 *Nesothrips hawaiiensis* Kirkaldy. Proc. Haw. Ent. **1**: 103.

1910 *Oedemothrips laticeps* Bagnall. Fauna Hawaiiensis; **3** (6) : 680.

Female (apterous) : General color by transmitted light, dark brown to black; fore tibiae, all tarsi, base of third antennal segment, light translucent brown; a nearly black area showing on all tarsi near the distal end. Hypodermal pigment shows as red blotches through the transparent intersegmental membranes when these are stretched. Weak striation of the chitin is discernible only in caustic-treated specimens and is stronger on the sides of the head and disk of the metanotum than elsewhere. The pattern of striation is transversely reticulate.

Head 258 microns along mid-dorsal line from base to vertex; 273 microns wide just back of the eyes. Eyes together occupying one half of head width; separately, one fourth of head length along the margin. Sides converge weakly from eyes to slight collar-like thickening of chitin at base of head. Post-oculars long, not unusually thick, inserted well back from the eyes, slightly farther out from the mid dorsal line than the inner edge of the eyes. Interoculars somewhat longer than half the length of post-oculars, well in from the inner margin of the eyes on a line about a third of the eye length from their front margin. On the same line but very close to the eye margin another seta, very minute and difficult to observe but present in all specimens. Back of the post-oculars and nearer the mid-dorsal line, two other setae, much smaller than the interoculars but always conspicuous. Other small, possibly paired, setae on the cheeks cannot be accurately located on the dorso-ventral mounts available. The inner margin of the eyes in dorsal view is angularly rounded; the outer follows the outline of the head, not protruding and comprising about eight of the rather coarse facets, between which there is no pilosity. Ventrally the eyes are produced posteriorly and their outline is ellipsoidal, flattened at one end and constricted in the middle. The frons is produced into a flat rectangular plate which bears five pairs of setae: a very long pair forward, near the bases of the antennae, an equally long pair just above the base of the mouth cone, two minute and inconspicuous pairs between the latter and the transverse median line, and a somewhat longer pair above the median line and farther apart than the others. On each side of the frons, between the bases of the antennae and the eyes, there are two other paired setae, of which the upper one is the longer. The mouth cone is short, evenly rounded, reaching about two thirds of the way across the prosternum, bearing a pair of thin setae between the bases of the maxillary palpi. Maxillary palpi well developed, arising from shallow ovate depressions in which, semicircularly arranged, there are three or four setae with conspicuous bases; the basal segment short, about one fourth the length of distal segment, which tapers only slightly to a blunt tip armed with two or three thick, short, light-

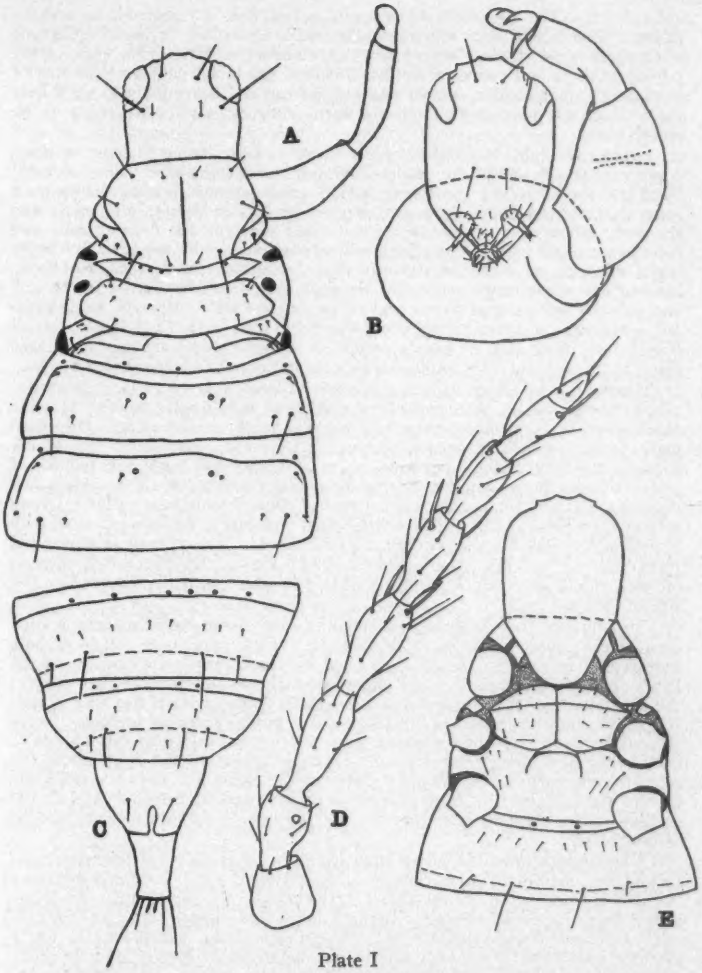

Plate I

Nesothrips hawaiiensis

A—Dorsal view of ♀, head, thorax, first and second abdominal segments.
B—Ventral view of ♂, showing mouth parts and location of transverse invagination of cuticle on dorsal surface of femur.
C—Ventral view of ♀, 7th, 8th, 9th and 10th abdominal segments.
D—Dorsal view of right antenna, ♀.
E—Ventral view of ♀, thorax and first abdominal segment. Setae of coxae and head not shown.

colored setae. The labrum, rather broadly tipped, does not protrude beyond the labium. The labial palpi are unusually small, irregularly cylindrical, armed with short setae; their segmentation not discernible. The distal edge of the labium is thick and curves around and behind the labial palpi and the tips of the labrum and maxillae, almost meeting in front and bearing six to eight long hairs which are regularly spaced and form a distinct circlet at the tip of the mouth cone.

Antennae eight segmented, approximate at base, twice as long as head, concolorous with body; by transmitted light segment three paler on basal third and showing dark transverse wrinkles; all segments except one bearing long, thin, translucent hairs arranged more or less in whorls, one below and the other above the transverse median line; segment one bearing no sense cone or sense pit and only one long hair on the inner side; segment two bearing a conspicuous sense pit dorsally near the distal margin; segment three bearing two sense cones ventrally; segment four, two dorsally; segment five, one on each side; segments six and seven, one dorsally; segment eight without sense pits or cones but with a long, thick hair at its tip. Sensory cones translucent, about half as long as segments bearing them, always borne near distal lip of segment, narrowing towards tip but not sharply pointed.

Prothorax 197 microns long; as wide as head in front; widening gradually to about middle, then smoothly rounded at hind angles to hind margin. Median suture dark, conspicuous, not reaching front or hind margin. Pronotal plate large, extending across prothorax in front, narrowing bisinuately towards the hind margin, making room at each hind angle for two other plates, the smaller of which is triangular and lies in front of the larger, which is trapezoidal and bears a thick short seta. Pronotal plate bears a long, strong seta at each hind angle; eight others, much smaller, as follows: four equally spaced on the fore margin, two on the hind margin, one on each side near the transverse median line. Also visible in dorsal view of the prothorax, there is on each side a short, thick, translucent bristle which is really inserted on the side of the fore coxa.

Prosternum chitinized only on shoulders and along caudal margin, a wide area of granulose membrane occupying the central portion, which is broadly indented to receive the mouth cone, and narrower bands curving about the bases of the fore coxae. A small, approximately rectangular sclerite occupies the front angle of the segment and a similarly shaped sclerite lies just inward from and slightly caudad of the first, their caudal margins forming a continuous curve in front of the coxa. Two sclerites joined along the midline to each other and along their straight caudal margins to the sclerites of the mesosternum form a plate that lies between the coxae and does not reach the disk of the segment; its front margin is arcuate and slightly indented on the midline where the two sclerites join and it bears four minute setae, two on each sclerite.

Pterothorax but little wider than prothorax and only 167 microns long; in mounted specimens appearing from dorsal view evenly outlined on sides, but probably not so in life, as the ventral plates of the segment are distinctly wider than the dorsal plates. Stigmata large and conspicuous; an elongate oval one placed dorso-ventrally on the fore angles of the mesothorax; a nearly circular one, dorsally on each side of the metathorax. Mesoscutum is short, sloping downward in front; its caudal margin straight and considerably shorter than the cephalic margin; its sides diverging anteriorly; bearing four exceedingly minute setae along posterior margin and a transverse row of five irregularly placed, circular pits near the transverse median line. Scutum and scutellum of metathorax fused without indication of suture; forming a roughly rectangular plate slightly wider and considerably longer than mesoscutum; its caudal and cephalic margins straight; its hind angles rounded; its front angles emarginate to fit around the metathoracic spiracles;

bearing two setae, one minute, on each end, above the spiracle, two longer ones on the hind margin, equidistant from the middorsal line, and a row of four minute ones on the transverse median line.

Mesosternum transversely rectangular; strongly curved on the sides to fit around middle coxae; weakly arcuate behind and the hind edge deeply and broadly invaginated in the center; curving sharply upwards along entire cephalic margin to join prosternum, which lies on a higher horizontal level than the rest of the ventral surface of the insect; divided into two side plates by a strong, straight median suture which is interrupted in back by the broad invagination of the caudal margin; each side plate bearing six small setae, two paired near the front margin, two on the median transverse line, and two, of which the inner is much longer than the outer, near the caudal margin. A small trapezoidal plate, the episternum, curves upwards on each anterior angle, just ahead of mesothoracic spiracle and is entirely separate from the mesosternum.

Metasternum transverse; considerably longer than mesosternum; weakly concave in front margin; almost straight caudally; narrowed and curving upwards on the sides between the middle and hind coxae; its front angles deeply excavate to curve around the middle coxae; its hind angles likewise curving around hind coxae; its front margin interrupted on either side of median line by a short, narrow, deep, longitudinal invagination of the chitinous disk of the segment; bearing on either, between the middle and hind coxae and almost on a median transverse line a long, strong seta, and inwards from this four much smaller ones, a pair cephalad and a pair caudad.

Legs in relation to size of body rather long but not unusually stout; the hind pair somewhat longer than the others; the front pair differing only in the relatively thicker femur; the coxae subconical, bearing several small setae but only the front pair with a conspicuous, thick, translucent seta on the outer side; the femora and tibiae bearing many dispersed, rather stiff setae which are generally longer on the distal third of the tibiae, and in addition a long thin, pale bristle outwardly on the distal end of the tibia and a similar one inwardly near the base of the femur. Tarsi two segmented; bearing several short, stiff, colorless setae; the division between segments oblique; the distal segment longer, with an almost black blotch on the ventral surface, bearing near the distal end, on what is the front surface as the insect walks, a strongly recurved claw which does not extend beyond the end of the segment.

Abdomen in relation to rest of body very large, in distended mounts twice as long as rest of body, elliptical in outline; of same width as pterothorax at base of first segment, widening rather suddenly to third segment, which is the widest and longest, narrowing gradually to fourth, thence more suddenly to base of tube. First abdominal segment shorter than metathorax, equally wide on front margin but considerably wider behind; its sides strongly convergent in front but parallel on their caudal halves, which are occupied by the upper portions of large spiracles placed dorso-ventrally on the sides of the segment; dorsally covered by three distinct plates, one roughly triangular occupying the base and central portion of the dorsum, two smaller ones, also triangular, occupying the anterior angles; the space between the chitinized plates occupied by a roughly granulose membrane; each side bearing three or four scattered, minute setae, and next to the spiracle a much stronger and conspicuous one; the central plate bearing a minute seta on each end near the hind margin and three equally spaced circular pits on a line joining the setae. Second segment is trapezoidal, with sides converging forward; three to six practically rectangular; seven, eight, and nine also trapezoidal but their sides strongly convergent caudally. On segments two to eight an area of heavier chitinization forms a plate which is broadly margined in front and back and narrowly margined on the sides by bands of weaker chitin that caudally merge into a broad granulose membrane. The cephalic margin of the plate is much more heavily chitin-

ized than the rest and appears in cleared specimens like a thin black line. The chaetotaxy of segments two to eight homologous, as follows: a small circular pit on each angle and one on each side of the mid-dorsal line, nearer to the cephalic than to the caudal margin of the segment; approximately in line with the latter but not always exactly so, four minute setae, two close to the circular pits and the other two near the side margins of the segment; on a transverse line cephalad about a third of the segment's length from the hind margin, six setae, three on each side, the inner minute in all the segments, the middle one relatively long in all the segments except eight, the outer one minute on segment two but gradually increasing until on segment seven it is the longest bristle on the body; on segment eight only the outer seta long, the two inner ones small. On segment nine the pits on the fore angles are not discernible in dorso-ventral mounts; the other two circular pits are larger and more widely spaced, being near the outer margins of the segment; of the three setae on each hind angle the middle one is small, the other two as heavy or heavier than the setae on segment seven but not as long. The eighth segment bears on the middle of each side a round spiracle, smaller than the thoracic ones and visible in dorso-ventral mounts only by deep focusing. The tube is characteristically stubby, about two-thirds the length of the head and about one half as wide at the end as it is at the base; the sides parallel on basal eighth, which is inserted in the ninth segment and visible only by transmitted light, then converging towards and roundly constricted just before the end; bearing on the caudal lip a circlet of six bristles longer than the tube and seven about half as long which alternate regularly on the dorsum and sides but not ventrally, where on either side of the dorso-ventral axis there is a shorter, characteristically sword-shaped seta.

The ventral arrangement of the abdominal segments is homologous from the first to the eighth. Each segment consists of a wide transverse band of chitin outlined in front by a thin black line of heavier chitinization, and margined narrowly in front and broadly behind by bands of coarsely granulose membrane. On the membrane in front is borne a row of circular pits; two on segment one, each flanked by a minute seta, six more or less regularly spaced on segments two to seven, four on segment eight. Near the cephalic margin of the chitinized band and reaching nearly from side to side is borne a transverse row of minute setae, from 8 to 12 on segments one to seven and only 4 on segment eight. On the caudal margin of the chitinized band is another row of four setae which are short and weak on segments one to five but become more than half as long as the segment on six to eight, the middle pair on these segments and on segment one being much longer than the outer. Unparalleled on the other segments, there are two minute setae on the caudal membrane of segment eight, one on either side of the midline. The caudal margin of segment nine is deeply, widely, bisinuately indented on the midline to form the genital opening, and on either side of the opening nearly on the transverse median line is a fairly long and strong seta.

Measurements of female holotype in mm., followed by measurements of metatype in parentheses, except in case of the setal measurements, which could not be obtained from the poorly mounted holotype and were all made on a metatype: Length about 2.35 (2.128); length of head .258 (.228); width across cheeks .273 (.228); median length of pronotum .197 (.182); greatest width of pronotum, including fore-coxae .410 (.334); median length of pterothorax .167 (.122); greatest width of pterothorax .516 (.410); greatest width of abdomen (segment III) .714 (.577); median length of tube .167 (.153); width of tube at base .105 (.091); width of tube at end .055 (.045); postocular setae .100; interocular setae .058; setae on anterior angles of prothorax .036; lateral setae on prothorax .048; outer setae on posterior angles of prothorax

.033; inner setae on posterior angles of prothorax .094; setae on 7th abdominal segment .183; setae on ninth abdominal segment .100; longest setae at end of tube .143.

Antennal segments	1	2	3	4	5	6	7	8	Total
Metatype	.0336	.0550	.0856	.0856	.0765	.0642	.0489	.0336	.483
Holotype	.0451	.0615	.1025	.0820	.0820	.0697	.0574	.0328	.533

Male (apterous): Not essentially different from the female except as follows: Somewhat smaller; length about 1.67 mm. (not distended). The prothorax is relatively longer and wider and its sides instead of converging forward are evenly rounded. The disk of the prosternum instead of being wholly membranous is occupied by two small thinly chitinized plates, more or less triangular in shape and separated from the two basal plates and from each other by thin sutures, from the fore-coxae and the shoulder pieces by narrow bands of granulose membrane. The fore-coxae occupy a relatively larger portion of the prosternum and their thick translucent setae are relatively smaller than in the female and not visible in dorsal view. The fore-femora are strongly incrassate; the chitin of their dorsal surface narrowly but deeply folded into a transverse invagination just distal of the median-transverse line. The caudal segment of the fore-tarsus is produced inwardly into a strong claw extending well beyond the margin of the fore-tibia. The ventral and dorsal chaetotaxy as in the female, but the structure of the ninth abdominal segment and the tube modified in the usual tubuliferan manner. Ventrally the discal portion of the ninth segment is joined to the base only, being more or less arcuately cut off from the sides into a scale which reaches farther back than the straight dorsal margin of the segment and overlaps the base of the tube. The base of the tube is straight dorsally but arcuately emarginated ventrally.

Measurements of male (metatype) in mm.: Length of head .258; width of head .243; length of prothorax .241; width of prothorax .425; width of fore-femur (transverse median line) .168; maximum width of abdomen (third segment) .562; width of tube at base .113; width of tube at end .045; length of tube .184; postocular setae .110; interocular setae .072; inner setae at posterior angles of prothorax .123; outer setae at posterior angles of prothorax .028; longest (outer) setae on the 7th segment .184; longest setae on the 8th segment .082; longest setae on the 9th segment .09; longest setae at end of tube .184.

Antennal segments	1	2	3	4	5	6	7	8	Total
	.0492	.0574	.0984	.0861	.0820	.0615	.0533	.0369	.524

Described from the following material which, to the author's knowledge, comprises all the collections ever made in the Territory, with the exception of Bagnall's:

1—The ♀ holotype: O. H. Swezey, collector; "probably on flowers"; Mt. Tantalus, Oahu; August 12, 1906; now in the collection of the Experiment Station, H.S.P.A.

2—The ♂ allotype: on the same slide as the holotype and with the same data.

3—One ♂: E. C. Zimmerman, collector; beating; Palikea, Waianae Mts., Oahu; November 2, 1936; in the Bishop Museum.

4—One ♀: N. H. Krauss, collector; beating; Waikolo valley region, Molokai; 3,500 ft. elevation; October, 1943; in the collection of the Pineapple Research Institute.

The Hawaiian Species of Enicospilus and Abanchogastra (Hymenoptera: Ichneumonidae)

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(Presented at the meeting of September 13, 1943)

The species of *Enicospilus* indigenous to the Hawaiian Islands form a very distinct group within the genus, characterized by a peculiarly fine, mat sculpture, especially of the thorax, and exhibiting wide variation in color and a marked tendency in several of the species to break up into size-races and color-races. A considerable number of these variations have been described as distinct species and some later synonymized. All have the head with the same basic yellow or whitish color pattern embracing the orbits, face, and clypeus, usually the vertex, and rarely almost the entire head; in red forms the pattern is sometimes suppressed by lack of contrast, and rarely in dark forms it is largely reduced by the encroachment of the dark color. It should be noted that the dark color of none of the species is a true black but results from the addition of more or less black pigment to the typical ferruginous color.

Only three authors—Cameron, Ashmead and Perkins—have described Hawaiian species, and of these only Perkins had anything like a clear understanding of them. The last-named author[1] has made a very critical study of large numbers of specimens, and has summarized admirably the variation occurring in most of the species, especially in size, in color, and in the strength of the propodeal carina. It is unnecessary here to discuss this matter further. Suffice it to state that in order to identify species with certainty it is necessary to ignore color almost entirely, except in a few species, and depend upon structure. Among the most useful characters are the size, shape and position of the fenestra and of its scleromes, the former very constant, the latter variable, except for position, in most species; the degree and position of the thickening of the basal abscissa of the radius; the course and thickness of the discocubitus and the length of the second recurrent in relation to the basal abscissa of the subdiscoideus and the angle formed by these two veins and the consequent shape of the second discoidal cell; the relative lengths of the veins of the transverse brace (intercubitus, second abscissa of cubitus and second recurrent); the convexity of

[1] Fauna Hawaiiensis, 1,(6), Introduction: cix-cx, 1913, and Trans. Ent. Soc. London, 1914: 521-535, 1915.

the eyes and length of the malar space with the resulting effect upon the shape of the head; the degree of attenuation of the abdomen; the form and length of the ovipositor; the form of the aedeagus; and the form of the apical tarsal joints, especially in the male. By the use of these characters the Hawaiian species can be divided into several groups, some already described as distinct genera, but apparently of not more than subgeneric status.

Previously published descriptions of the color and Perkins' analysis of the variation in color, size and some features of structure and sculpture render detailed descriptions of the species unnecessary. Descriptive matter in the following discussion of the species is confined largely to that referring to the fenestra and its scleromes and the shape of the second discoidal cell. These structures furnish the most reliable specific characters that I have found in the Hawaiian species. The other characters of the venation mentioned above, mostly subject to some variation, are brought out in the figures.

All the figures are from drawings by my son, Arthur D. Cushman, of the Bureau of Entomology and Plant Quarantine.

Including the two species described in *Pleuroneurophion* and the one in *Eremotylus,* 25 names have been applied to Hawaiian species of *Enicospilus,* as follows:

Pleuroneurophion hawaiiensis Ashmead.
P. ferrugineus Perkins.
(*Eremotylus*) *Eremotyloides orbitalis* (Ashmead).
(*Ophion*) *Enicospilus lineatus* (Cameron).
(*Ophion*) *Enicospilus nigricans* (Cameron), preoccupied by *Ophion nigricans* Ruthe, and renamed *Enicospilus nigritulus* Morley. Synonymized by Perkins with *castaneus* Ashmead.
Enicospilus mauicola Ashmead.
Enicospilus kaalae Ashmead.
Enicospilus waimeae Ashmead.
Enicospilus variegatus Ashmead.
Enicospilus nigrolineatus Ashmead.
Enicospilus castaneus Ashmead.
Enicospilus henshawi Ashmead. Synonymized by Perkins with *lineatus* (Cameron).
Enicospilus molokaiensis Ashmead.
Enicospilus longicornis Ashmead.
Enicospilus semirufus Perkins. Synonymized by Perkins with *kaalae* Ashmead.
Enicospilus dispilus Perkins.
Enicospilus dispilus var. *pallipes* Perkins.
Enicospilus dimidiatus Perkins. Synonymized by Perkins with *mauicola* Ashmead.

Enicospilus tyrannus Perkins.
Enicospilus capnodes Perkins. Synonymized by Perkins with *mauicola* Ashmead.
Enicospilus melanochromus Perkins.
Enicospilus funereus Perkins.
Enicospilus ashmeadi Perkins.
Enicospilus bellator Perkins.
Enicospilus pseudonymus Perkins.

To these I am adding two new species, both in the subgenus *Eremotyloides*.

Among the more than 400 specimens that I have examined, including those in the United States National Museum and a lot kindly sent me by Elwood C. Zimmerman of the Bernice P. Bishop Museum in Honolulu (some identified by Perkins) I have recognized all but four of the species listed above. Of these four, *ferrugineus* Perkins and *pseudonymus* Perkins are placed in the following key on characters given in the original descriptions; and of the other two (*funereus* Perkins and *tyrannus* Perkins) the probable or possible positions are indicated.

The holotypes of all species of Ophionini described by Cameron, Ashmead, and Perkins (except that of *Pleuroneurophion hawaiiensis* Ashmead, which is in the United States National Museum) are in the British Museum.

In the key and discussions the terms *fenestra* and *sclerome* correspond to Perkins' terms "hyaline glabrous area of the discocubital cell" and "chitinous spot of the discocubital cell."

KEY TO HAWAIIAN SUBGENERA AND SPECIES OF ENICOSPILUS

1. Fenestra more or less distinct; mesoscutum of normal conformation 2
   Fenestra lacking; mesoscutum "somewhat strongly compressed at the sides in such a way that the middle third of its width appears elevated" ..... (♂) 17. **pseudonymus** Perkins.
2. Abdomen extremely slender, tergites 1-5 in female, 1-4 in male, longer than deep (fig. 17); ovipositor very short, stout, and recurved (fig. 17); (aedeagus as in fig. 2a) (subgenus *Eremotyloides* Perkins) 3
   Abdomen less conspicuously slender, tergite 4 in both sexes deeper than long; ovipositor straight and not especially short, rarely strongly exserted 5
3. Basal abscissa of radius straight, thickened only in about basal third; fenestra small, not extending beyond the thickening; sclerome, when present, broadly oval and lying along proximal margin of fenestra (figs. 1 and 2) 4
   Basal abscissa of radius with a slightly curved thickening occupying more than its basal half; fenestra large, embracing fully half the apical portion of the discocubital cell; sclerome long and narrow and lying along lower margin of fenestra (fig. 3) ..... 3. **fullawayi,** new species.

4. Fenestra without sclerome (fig. 1); second abscissa of cubitus thrice as long as intercubitus (fig. 1); metapleura moderately convex (fig. 21).....(♀ ♂) 1. **orbitalis** (Ashmead).
   One sclerome present, the proximal, this rather large, oval, with its long axis vertical to costal margin (fig. 2); metapleura conspicuously convex (fig. 22).....(♀ ♂) 2. **perkinsi,** new species.
5. Discocubitus sharply angled and with a short, thick ramellus; fenestra extremely small, below base of radius, usually with a very minute, colorless proximal sclerome on lower proximal margin (fig. 4); ovipositor prominently exserted (fig. 18); (aedeagus as in fig. 4a) (subgenus *Pleuroneurophion* Ashmead).....6
   Discocubitus at most weakly angled and without ramellus; fenestra not as above; ovipositor not exserted (subgenus *Enicospilus* Stephens).....7
6. Dark brown.....(♀ ♂) 4. **hawaiiensis** (Ashmead).
   Ferruginous.....(sex?) 5. **ferrugineus** (Perkins).
7. Fenestra occupying fully three-fourths width and nearly half area of narrow distal portion of discocubital cell, with one sclerome, the proximal, which is small, oval or pyriform, and on lower proximal margin of fenestra, closer to discocubitus than to radius and basad of a line drawn perpendicular to costa through base of radial cell (figs. 5-7); female hypopygium very prominent (fig. 19).....8
   Fenestra smaller and narrower, proximal sclerome, when present, closer to radius than to discocubitus, usually distad of base of radial cell (figs. 8-15), female hypopygium not especially prominent (fig. 20).....10
8. Discocubitus at least slightly thickened at junction of first recurrent and cubitus and sometimes slightly angled (figs. 5 and 6).....9
   Discocubitus neither thickened nor angled (fig. 7).....(♀ ♂) 8. **kaalae** Ashmead.
9. Thorax laterally mat, densely ruguloso-punctate to rugulose; discocubitus usually angulate (fig. 5); aedeagus as in fig. 5a; ferruginous.....(♀ ♂) 6. **molokaiensis** Ashmead.
   Thorax laterally shining, very minutely alutaceous and finely irregularly aciculate and sparsely punctate; discocubitus not angulate (fig. 6); aedeagus as in fig. 6a; dark.....(♂) 7. **melanochromus** Perkins.
10. Fenestra small, usually about as long as broad, not or barely a third as long as basal abscissa of radius (figs. 8-9, 11-13), rarely (*bellator*, fig. 10) represented only by a narrow hairless area along radius; aedeagus as in figs. 8a and 11a.....11
    Fenestra rather large, fully half as long as basal abscissa of radius (figs. 14 and 15); aedeagus as in figs. 14a and 15a.....16
11. Scutellum transversely flat between carinae, very densely punctate or rugulose and dull, carinae usually prominent; length of malar space at dorsal articulation of mandible, at least in female, nearly or quite half as long as basal width of mandible; apical tarsal joint in male (fig. 24) strongly depressed, parallel-sided or even broader toward base than at apex.....12
    Scutellum transversely convex between carinae, more sparsely punctate and usually more or less shining, if dull the surface very finely mat and with well separated punctures, carinae not unusually prominent; malar space distinctly less than half as long as basal width of mandible; apical tarsal joint (fig. 25) broadening toward apex and not especially depressed.....14

12. Fenestra not exceptionally small, usually with a well defined proximal sclerome and frequently a trace of a central sclerome, rarely without scleromes (figs. 8 and 9).....13
Fenestra very small and narrow with no proximal sclerome, but with a faintly sclerotized lower margin (fig. 10).....
.....(♀ ♂) 11. **bellator** Perkins.

13. Head distinctlv elongate, apparently longer from vertex to apical margin of clypeus than broad, eyes rather shallowly convex, malar space in female more than half, in male about half, as long as basal width of mandible; fenestra with only the proximal sclerome (fig. 8), rarely without any; antenna, especially in female, unusually short.....(♀ ♂) 9. **castaneus** Ashmead.
Head broader than long, eyes deeply convex, malar space in female barely, in male less than, half as long as basal width of mandible; fenestra with large proximal and small central sclerome (fig. 9); antenna long.....(♀ ♂) 10. **dispilus** Perkins.

14. Thorax, legs, and abdomen not contrastingly colored, mostly dark or mostly red; scutellum finely punctate and more or less shining 15
Thorax and legs yellowish and black; abdomen dark with dorsal edge yellow; scutellum coarsely punctate and mat.....
.....(♀ ♂) 14. **variegatus** Ashmead.

15. Sclerome very large, nearly equal to fenestra in area (fig. 12).....
.....(♀) 13. **waimeae** Ashmead.
Sclerome much smaller, sometimes lacking (fig. 11).....
.....(♀ ♂) 12. **lineatus** (Cameron).

16. Fenestra with only one sclerome, the proximal, this distinctly distad of a line perpendicular to costal margin through base of radial cell, elongately triangular and with a more or less distinct appendix to apex of fenestra (fig. 14); yellowish, with prescutum, mesosternum and propodeum largely black; aedeagus as in fig. 14a.....(♀ ♂) 15. **nigrolineatus** Ashmead.
Fenestra with two scleromes, the proximal almost equilaterally subtriangular without appendix and basad of a line perpendicular to costal margin at base of radial cell and a central sclerome irregularly elongate or subovate (fig. 15); ferruginous, at most with piceous stains on thorax; aedeagus as in fig. 15a.....
.....(♀ ♂) 16. **longicornis** Ashmead.

Subgenus **Eremotyloides** Perkins

Eremotyloides Perkins, Trans. Ent. Soc. London, 1914: 530, 1915.

Genotype.—*Eremotylus orbitalis* Ashmead (p. 532). Monobasic.

This subgenus differs from the typical subgenus virtually only in the extreme slenderness of the abdomen (sometimes less evident in the male) and in the short, recurved ovipositor (fig. 17). Its status as a subgenus may be found to be untenable when the *Enicospilus* fauna of the world is studied, but within the fauna of the restricted area it differs so conspicuously from the bulk of the species that it seems well to recognize it.

1. **Enicospilus (Eremotyloides) orbitalis** (Ashmead), new combination

Eremotylus orbitalis Ashmead, Fauna Hawaiiensis, **1** (3) : 345, 1901.

Eremotyloides orbitalis (Ashmead), Perkins, Trans. Ent. Soc. London, 1914 : 532, 1915.

Of this species I have seen three males and one female, each from a different island: Hawaii, Koebele; Oahu, Waianae Mts., 2,500 feet, May 1892, Perkins; Kauai, Mts. Waimea, 4,000 ft., 1894, Perkins; Maui, Honomanu, June 28, 1920, E. H. Bryan, Jr.; the first three in the United States National Museum, the last in the Bernice P. Bishop Museum.

All these specimens are dark, but Perkins records specimens with red thorax and pale legs, and suggests the possibility of there being an entirely pale form.

The sculpture of the thorax in this species is notably finely and evenly alutaceous and mat, with very little tendency to rugulosity except on the propodeum, where it is very fine. The second discoidal cell (fig. 1) is notably short and broad, with the discocubitus strongly arched and the second recurrent much more than half as long as the basal abscissa of the subdiscoideus. The radius is thickened only in about its basal third, and the fenestra is very small and rather poorly defined and lacks all trace of scleromes.

2. **Enicospilus (Eremotyloides) perkinsi,** new species

Very distinct from *orbitalis* in the possession of a rather large, dark-colored sclerome and from all recorded specimens of that species in its largely or entirely bright ferruginous color.

Female (holotype).—Length 19.0 mm., antenna 12.0 mm., forewing 11.0 mm.

Much more shining than *orbitalis* and virtually lacking the very fine alutaceous sculpture characteristic of that species.

Face sparsely punctate, slightly wider at level of clypeal foveae than frons; clypeus punctate only basally; head elsewhere polished. Pronotum obliquely striate laterally; mesoscutum subpolished, very finely and sparsely punctate discally; scutellum rather strongly convex between carinae, very finely alutaceous and more coarsely punctate than mesoscutum; mesopleuron and metapleuron striato-rugulose, metapleuron prominently convex (fig. 22); prepectus striato-punctate; mesosternum sparsely punctate; propodeum without carina, finely mat basad of normal position of carina, irregularly rugose apicad, slightly impressed medially. Forewing (fig. 2) with basal abscissa of radius strongly swollen in basal third; fenestra very small, at extreme base of radius, with dark, broadly oval, and sharply defined proximal sclerome with long axis nearly perpendicular to costal margin; intercubitus two-thirds as long as second abscissa of cubitus, which is somewhat longer than second recurrent; discocubitus arched in middle so that discoidal cell is wider there than at apex; nervulus distinctly antefurcal; nervellus broken somewhat below middle. Legs, especially femora, rather stout, coxae and femora shin-

ing, very minutely sculptured. Abdomen (fig. 17) shining, nearly three times as long as head and thorax combined, exceedingly slender, fifth tergite distinctly longer than deep, hypopygium extending slightly beyond apex of last tergite so that sheath is directed somewhat dorsocephalad; ovipositor short, stout basally, recurved.

Bright ferruginous; head almost uniformly colored; abdomen blackish from near base of third tergite to apex.

Male (allotype).—Essentially like holotype. Aedeagus as in fig. 2a.

Type locality.—Kokee, Kauai.

Holotype and *allotype.*—Bernice P. Bishop Museum.

Paratypes.—No. 56660, United States National Museum.

Two specimens of each sex, all from Kauai, the holotype taken at light July 6, 1937, by E. C. Zimmerman; the allotype, in September, B. P. Clark; the female paratype at 4,000 ft. April 28, 1919, J. A. Kusche; and the male paratype at Kaholuamano, April 1920, J. A. Kusche.

In the female paratype the dark color on the abdomen is very dilute, and the two males are intermediate in this respect.

3. **Enicospilus (Eremotyloides) fullawayi,** new species

Female.—Length 19.0 mm., antenna 12.0 mm., forewing 11.0 mm.

Extremely similar in habitus, structure, sculpture, and color to *orbitalis,* and differing virtually only by the following characters:

Thickening of radius (fig. 3) gently curved and occupying nearly two-thirds of the length; fenestra very large, occupying about three-fourths the width and fully half the area of apical portion of discocubital cell; proximal sclerome linear and lying along lower margin of fenestra at proximal end entirely proximad of a line through base of radial cell perpendicular to costal margin, second discoidal cell rather narrow, discocubitus gently arched, second recurrent distinctly less than half as long as basal abscissa of subdiscoideus.

Type locality.—Halemanu, Kauai.

Holotype.—No. 56661, United States National Museum.

A single female captured June 8, 1919, by H. T. Osborn.

Subgenus **Pleuroneurophion** Ashmead

Pleuroneurophion Ashmead, Proc. U. S. Nat. Mus. 23: 86, 1900; Fauna Hawaiiensis, 1(3): 342, pl. 9, fig. 1, 1901; Perkins, Trans. Ent. Soc. London, 1914: 521, 529, 1915.

Genotype.—*Pleuroneurophion hawaiiensis* Ashmead.

Both the angulate and thickened discocubitus and the very small fenestra situated at the very base of the radius (fig. 4) characteristic of this subgenus occur elsewhere in *Enicospilus,* usually not in combination. Among the Hawaiian species the angulate discocubitus appears in *molokaiensis,* though in much less exaggerated form, but that species has a large fenestra. The fenestra in *orbitalis* and

perkinsi of the subgenus *Eremotyloides* is comparable in size and location to that of *Pleuroneurophion,* but there is no trace of thickening or angulation of the discocubitus. The only really anomalous character of this subgenus is the strongly exserted ovipositor (fig. 18). None of the Oriental species referred, because of the angled discocubitus, to *Pleuroneurophion* by Cameron, Szepligeti, and Uchida agrees with the character of the ovipositor.

4. **Enicospilus (Pleuroneurophion) hawaiiensis** (Ashmead), new combination

Pleuroneurophion hawaiiensis Ashmead, Proc. U. S. Nat. Mus. **23**: 86, 1900; Fauna Hawaiiensis, **1** (3): 342, pl. 9, fig. 1, 1901.

I have examined 48 specimens of both sexes, including the unique type, 10 specimens identified by Ashmead as *Ophion nigricans* Cameron, and 37 received from Mr. Zimmerman, all taken in the neighborhood of Humuula. All specimens are from the island of Hawaii. This fact may account for the very great uniformity in size and very dark color of the specimens.

5. **Enicospilus (Pleuroneurophion) ferrugineus** (Perkins), new combination

Pleuroneurophion ferrugineus Perkins, Trans. Ent. Soc. London, 1914: 533, 1915.

There is nothing in the very brief description of this species, except the color, that will distinguish it from *hawaiiensis,* and it may prove to be merely the red phase of that species. It is known only from the island of Maui. Perkins gives no indication of the number, size or sex of the specimens that he had.

Subgenus **Enicospilus** Stephens

6. **Enicospilus (Enicospilus) molokaiensis** Ashmead

Enicospilus molokaiensis Ashmead, Fauna Hawaiiensis, **1** (3): 344, 1901; Perkins, Trans. Ent. Soc. London, 1914: 523, 533, 1915.

This and the next two species form a group characterized by the large fenestra (figs. 5-7) occupying nearly half the area and fully three-fourths of the width of the apical portion of the discocubital cell, with the small pyriform or oval proximal sclerome at the lower proximal angle closer, usually much closer, to the discocubitus than to the radius and mostly or entirely proximad of a line perpendicular to the costa through the base of the radial cell; the discocubitus (except in *kaalae*) more or less thickened in the middle and sometimes (*molokaiensis*) angulate or subangulate, but without a ramellus; the second discoidal cell with upper and lower margins subparallel for fully half its length (fig. 19); and the aedeagus

(figs. 5a and 6a) with the apical, bulblike swelling not rising above the general dorsal margin.

The present species, of which I have seen about 70 specimens from Oahu, Hawaii, Kauai, Maui and Molokai, is unusually constant in color, apparently always ferruginous, and exhibits a gradation in size from 10 to 20 mm., with the smaller specimens predominating.

Thickening of radius (fig. 5) occupying about the basal half of abscissa and with a slight upward curvature; sclerome elongate pyriform with a longer or shorter appendix, just proximad of a line perpendicular to costa through base of radial cell; intercubitus one-fourth to one-third as long as second abscissa of cubitus, which is much longer than second recurrent; discocubitus with thickening angulate or subangulate, cubital portion nearly straight; second discoidal cell narrow, upper and lower margins parallel, lower posterior angle approximately a right angle, second recurrent a third or less as long as basal abscissa of subdiscoideus; aedeagus (fig. 5a) very weakly swollen below at apex.

7. **Enicospilus (Enicospilus) melanochromus** Perkins

Enicospilus melanochromus Perkins, Trans. Ent. Soc. London, 1914: 523, 533, 1915.

Of this species, described only in a key to the Hawaiian species, I have seen only two males, both from Mt. Tantalus, Oahu, and both identified by myself by comparison with the description. If these specimens are correctly identified the species can be distinguished from *molokaiensis* by its dark color; by the greater length of the thickened portion of the radius; by the broader and less attenuated sclerome; by the longer intercubitus, which is about half as long as the second recurrent; by the somewhat less distinctly angulate and thickened discocubitus; by the acute lower posterior angle of the second discoidal cell (fig. 6); and by the more strongly swollen apex of the aedeagus (fig. 6a).

8. **Enicospilus (Enicospilus) kaalae** Ashmead

Enicospilus kaalae Ashmead, Fauna Hawaiiensis, 1 (3): 347, 1901; Perkins, Fauna Hawaiiensis, 2 (6): 57, 1910; Trans. Ent. Soc. London, 1914: 524, 533, 1915.

Enicospilus semirufus Perkins, Trans. Ent. Soc. London, 1902: 142; Morley, Rev. Ichn. Brit. Mus., 1: 48, 1912.

Of this species I have seen 25 specimens from Oahu, Kauai, and Maui.

In both size and color it is unusually constant, being large and blackish with the abdomen dark red except the petiole and the apex.

Perkins himself synonymized his *semirufus* with *kaalae*.

This species shares with *molokaiensis* and *melanochromus* the large fenestra (fig. 7) with the small, oval, proximal sclerome at the lower proximal corner of the fenestra and basad of a line perpendicular to the costa at the base of the radial cell and the prominent female hypopygium (fig. 19); but differs from both in the evenly curved and unthickened discocubitus and from *molokaiensis* in the form of the aedeagus, in which it resembles *melanochromus*. The sclerome varies slightly in shape and size; the intercubitus is about half as long as the second abscissa of the cubitus; and the second recurrent is about one-third as long as the basal abscissa of the subdiscoideus, these two veins forming a right or slightly obtuse angle (fig. 7).

9. **Enicospilus (Enicospilus) castaneus** Ashmead

Ophion nigricans Cameron, Trans. Ent. Soc. London, 1883: 193 (preoccupied by *O. nigricans* Ruthe, Stett. Ent. Zeitg. **20**: 378, 1859); Ashmead, Fauna Hawaiiensis, **1** (3): 341, 1901.

Enicospilus castaneus Ashmead, Fauna Hawaiiensis, **1**(3): 349, 1901; Perkins, Trans. Ent. Soc. London, 1914: 528, 534, 1915.

Ophion nigritulus Morley, Rev. Ichn. Brit. Mus., **1**: 64, 1912 (substitute name for *O. nigricans* Cameron, preoccupied).

This and the next five species (figs. 8-13) constitute a group characterized as follows: Fenestra rather small, about as broad as long and underlying much less than half length of basal abscissa of radius, proximal sclerome very variable in size and shape, and sometimes absent, but when present always distad of a line perpendicular to costal margin at base of radial cell, rarely (*bellator*, fig. 10) fenestra reduced to a narrow area without sclerome; aedeagus (figs. 8a, 11a) with apex very strongly swollen both below and above. The three species of which I have seen abundant material (*castaneus, dispilus* and *lineatus*) are among the most protean in the genus with respect to both size and color of individuals and size and form of the proximal sclerome.

The present species, of which I have seen more than 100 specimens, all from the island of Hawaii, exhibits all gradations in color from entirely ferruginous (*castaneus*) to almost entirely black (*nigritulus*) and in size from 13 mm. to 23 mm. The sclerome varies from a fairly large, triangular sclerome to total absence.

This and the next two species differ from the other three species of the group in the transversely flat and very densely and coarsely punctate scutellum with unusually high carinae, in the unusually long malar space, in the second discoidal cell being long and narrow with its upper and lower margins parallel in about its apical third

and, in the male, in having the apical tarsal joints (fig. 24) strongly depressed and parallel-sided or even a little broader basad of middle than at apex. The malar space reaches its maximum length in the female of the present species, in which it is combined with unusually shallowly convex eyes to produce a relatively long, narrow head. The antennae in *castaneus*, especially in the female, are unusually short, not reaching the apices of the spread wings. The male is less easily distinguished from that of *dispilus*, but has the malar space definitely longer and always lacks a central sclerome in the fenestra, whereas *dispilus* has at least a trace of one.

10. **Enicospilus (Enicospilus) dispilus** Perkins

Enicospilus dispilus Perkins, Trans. Ent. Soc. London, 1902: 143; 1914: 528, 534, 1915.

Enicospilus dispilus var. *pallipes* Perkins, Trans. Ent. Soc. London, 1902: 143.

I have seen 40 specimens from Oahu, Molokai, Maui, Hawaii, and Kauai. In his 1915 paper Perkins does not mention his variety *pallipes* by name, merely stating that "Kauai specimens have the antennae and more or less of the legs pale, yellowish-brown." So far as can be judged from the few specimens from that island that I have seen, this difference seems to hold. All of the specimens from the island of Hawaii that I have seen are largely or entirely ferruginous, only restricted areas of the thorax being somewhat darker in some specimens. This form appears not to have been named, possibly because of confusion with *castaneus*, which was the case with most of the ferruginous specimens in the National Museum, though one was erroneously labeled *waimeae* by Ashmead.

The species is easily distinguished from its closest relative (*castaneus*) by the wing characters (fig. 9) of moderately large triangular proximal sclerome and very small almost colorless central sclerome, shorter malar space, and strongly convex eyes.

11. **Enicospilus (Enicospilus) bellator** Perkins

Enicospilus bellator Perkins, Trans. Ent. Soc. London, 1914: 528, 533, 1915.

This species, of which I have seen only four specimens from Hawaii and one from Molokai, is very distinct in the form of the fenestra (fig. 10), which is about twice as long along radius as broad and lacks distinct scleromes, although there is a faint sclerotization along the lower margin. All five specimens are ferruginous, like the type.

12. **Enicospilus lineatus** (Cameron)

Ophion lineatus Cameron, Trans. Ent. Soc. London, 1883: 192; Ashmead, Fauna Hawaiiensis 1 (3): 342, 1901.

Enicospilus mauicola Ashmead, Fauna Hawaiiensis, 1 (3): 347, 1901; Perkins, Trans. Ent. Soc. London, 1914: 526, 534, 1915. New synonymy.

Enicospilus henshawi Ashmead, Fauna Hawaiiensis, 1 (3): 349, 1901.

Enicospilus dimidiatus Perkins, Trans. Ent. Soc. London, 1902: 143; Morley, Rev. Ichn. Brit. Mus., 1: 49, 1912. New synonymy.

Enicospilus capnodes Perkins, Fauna Hawaiiensis, 2 (6): 679, 1910. New synonymy.

Henicospilus lineatus (Cameron) Morley, Rev. Ichn. Brit. Mus., 1: 47, 52, 1912.

Enicospilus lineatus (Cameron) Perkins, Trans. Ent. Soc. London, 1914: 526, 1915.

Enicospilus ashmeadi Perkins, Trans. Ent. Soc. London, 1914: 527, 1915. New synonymy.

This and the next two species differ as a group from the three preceding species in the form of the second discoidal cell, which is shorter and broader with its upper and lower margins convergent from somewhat basad of the apical third to the apex, and in the more strongly convex scutellum with lower carinae and sparser sculpture.

This abundant species exhibits to the extreme the tendency to break up into color-phases and size-phases. The names *lineatus* and *henshawi* represent the small red form, *dimidiatus* the small dark form, and *mauicola* and *capnodes* the large dark form, while the large red form has not been named; *ashmeadi* represents both of the large forms without the sclerome. In the material that I have examined there is comparatively less intergradation between the forms than in any of the other species. The names applying to the various phases may be of use in certain sorts of studies but I doubt their taxonomic value.

The three valid names in the varietal sense are *lineatus, dimidiatus,* and *mauicola.* The others, *capnodes* and *ashmeadi,* are synonymous with *mauicola.* The coarser punctation on the scutellum of *ashmeadi* is merely variation, while the lack of the sclerome, another character of *ashmeadi,* occurs also in both the light and dark specimens in which the scutellum is weakly punctate.

In listing *henshawi* among the synonyms of *lineatus* I am following Perkins, despite the fact that Ashmead himself identified as *henshawi* a specimen of *Abanchogastra hawaiiensis* (Ashmead),

apparently at the time he wrote the paper in which both *hawaiiensis* and *henshawi* were described. It seems possible that this is another instance like that pointed out by Perkins in which Ashmead described from a single specimen his *Pleuroneurophion hawaiiensis* and then identified other specimens of the same species as *Ophion nigricans* Cameron. However, since Perkins has synonymized *henshawi* with *lineatus* after seeing the types of both species it seems best at this time to follow his synonymy.

When present, the proximal sclerome (fig. 11) is distinctly distad of a line perpendicular to the costal margin at the base of the radial cell.

Enicospilus funereus Perkins

Enicospilus funereus Perkins, Trans. Ent. Soc. London, 1914: 525, 1915.

Some specimens that I identify as the large dark form of *lineatus* (*mauicola*) agree fairly well with the description of this species, and I suspect that it should be synonymized. The only character that I cannot find in one or another specimen of *lineatus* is the "unusually strongly and densely punctured" second tergite, and I suspect that the punctured appearance is due to the drying of some foreign fluid at the bases of the fine hairs, such as I have observed on a few specimens. In Perkins' key, in which the only description of the species occurs, it is finally separated from *mauicola, lineatus,* and *ashmeadi,* all herein treated as synonymous.

13. **Enicospilus (Enicospilus) waimeae** Ashmead

Enicospilus waimeae Ashmead, Fauna Hawaiiensis, 1 (3): 348, 1901; Perkins, Trans. Ent. Soc. London, 1914: 525, 533, 1915.

There is in the United States National Museum one female specimen with the sclerome large as described by Perkins for the type specimen (fig. 12). Like the type it is from Mt. Waimea, Kauai, where it was taken at 4,000 ft. in 1894 by Perkins. Except for the size and form of the sclerome it differs hardly at all from large dark specimens of *lineatus,* and very likely will have to be synonymized with that species; but I have seen no other specimen that approaches it in the size of the sclerome. The sclerome also is somewhat farther basad than in *lineatus,* its proximal margin very slightly basad of a line perpendicular to the costal margin at the base of the radial cell.

14. **Enicospilus (Enicospilus) variegatus** Ashmead

Enicospilus variegatus Ashmead, Fauna Hawaiiensis, 1 (3): 348, 1901; Perkins Trans. Ent. Soc. London, 1914: 525, 533, 1915.

Of this very distinct species there are a female and a male,

the latter identified by Ashmead, in the United States National Museum.

In color the thorax is very similar to that of *nigrolineatus*, yellowish and black, but the black is much more extensive, including the lateral lobes of the mesoscutum, most of the area of the mesopleuron, the metapleuron, and all the propodeum except around the spiracles. Unlike that of *nigrolineatus* the abdomen is dark with the upper edge of the compressed portion yellowish. The fenestra (fig. 13) is essentially like that of *lineatus*, but with the proximal sclerome slightly farther basad and with a faint sclerotization along the distal margin of the fenestra.

15. **Enicospilus (Enicospilus) nigrolineatus** Ashmead

Enicospilus nigrolineatus Ashmead, Fauna Hawaiiensis, **1** (3) : 348, 1901 ; Perkins, Trans. Ent. Soc. London, 1914 : 524, 533, 1915.

One of the most distinct of the Hawaiian species, immediately recognizable by the only slightly variable color pattern of the thorax—yellowish ferruginous with a median black stripe on the mesoscutum and the mesosternum and the propodeum posterior to the carina also black. It is equally distinct in the form of the proximal sclerome (fig. 14), which is elongately triangular with appendix underlying the fenestra to the apex and is situated distinctly apicad of a line perpendicular to the costal margin at the base of the radial cell. The stigma is very narrow and the second discoidal cell narrow with upper and lower margins nearly parallel for about half the length and the second recurrent about a third as long as the basal abscissa of the subdiscoideus.

I have seen 23 specimens from Kauai, Oahu, Maui, Molokai, and Hawaii.

16. **Enicospilus (Enicospilus) longicornis** Ashmead

Enicospilus longicornis Ashmead, Fauna Hawaiiensis, **1** (3) : 350, 1901 ; Perkins, Trans. Ent. Soc. London, 1914 : 524, 533, 1915.

Of this distinct species I have seen only eight specimens, seven from Hawaii and one from Maui.

The fenestra (fig. 15) is rather large; there are two distinct scleromes, the nearly equilaterally triangular proximal and elongately oval central scleromes, the latter parallel to the costal margin, and usually with a faint trace of the distal sclerome. The proximal sclerome is almost entirely basad of a line perpendicular to the costal margin at the base of the radial cell. The stigma is unusually short and broad and the second discoidal cell short with the discocubitus straight basally and convexly curved in about its apical half, the second recurrent nearly half as long as the basal abscissa of the subdiscoideus.

In this species the mandible (fig. 23) bears a conspicuous tuft of long hairs on the outer surface between the middle and the apex. Several of the other species have a few hairs in this position, but in none are they so conspicuous as in *longicornis*.

All the specimens are almost uniformly ferruginous with the head largely or entirely yellowish.

Enicospilus tyrannus Perkins

Enicospilus tyrannus Perkins, Trans. Ent. Soc. London, 1914: 524, 1915.

In Perkins' key, which furnishes the only description of this species, it is finally separated from *longicornis* only by the character "mesosternum and at least most of the propodeum black," which leads to the suspicion that it is only a somewhat dark form of *longicornis*.

17. **Enicospilus pseudonymus** Perkins

Enicospilus pseudonymus Perkins, Trans. Ent. Soc. London, 1914: 529, 1915.

This species, apparently based on a single male, is unknown to me. The lack of a fenestra, the medially elevated mesoscutum (if this is not an abnormality), and the slender basal abscissa of the radius render it anomalous in *Enicospilus*, and I suspect that a new genus should be erected for it.

Abanchogastra hawaiiensis (Ashmead)

Athyreodon hawaiiensis Ashmead, Fauna Hawaiiensis 1(3): 343, pl. 9, fig. 2, 1901; Perkins, Fauna Hawaiiensis 2 (6): 679, 1910.

Abanchogastra debilis Perkins, Trans. Ent. Soc. London, 1902: 141. New synonymy.

Athyreodon debilis Perkins, Fauna Hawaiiensis 2 (6): 680, 1910.

This species exhibits in extreme degree the variation in color characteristic of the Hawaiian Ophionini.

Before me are 10 specimens (5 of each sex), a pair of the red phase identified by Perkins as *hawaiiensis*, a pair each of the dark and intermediate phases identified by Perkins as *debilis*, a male of the intermediate phase identified by me as *hawaiiensis*, a red female identified by Ashmead as *Enicospilus henshawi*, and a pair of the red phase identified, probably by D. T. Fullaway, as *hawaiiensis*. In the red phase the body and legs are almost uniformly ferruginous, with the base of the second tergite piceous and the orbits in the female and the face, frons, vertex, and orbits in the male yellow. In the intermediate phase (*hawaiiensis*) the ferruginous is largely

replaced by piceous, the vertex and frons in the female remaining ferruginous and the yellow pattern of the male head remaining the same as in the red phase. In the dark phase (*debilis*), the piceous color is deeper in tone, nearly black on the thorax, and embraces the vertex entirely and the frons medially. It should be noted that the female described by Perkins as *debilis* (hereby designated the lectotype) is of the dark phase whereas the male is of the intermediate phase and almost typical *hawaiiensis*.

The red phase has never been named unless it is indeed *Enicospilus henshawi*. Perkins examined the types of the Ashmead species in the British Museum, and apparently found no reason to doubt

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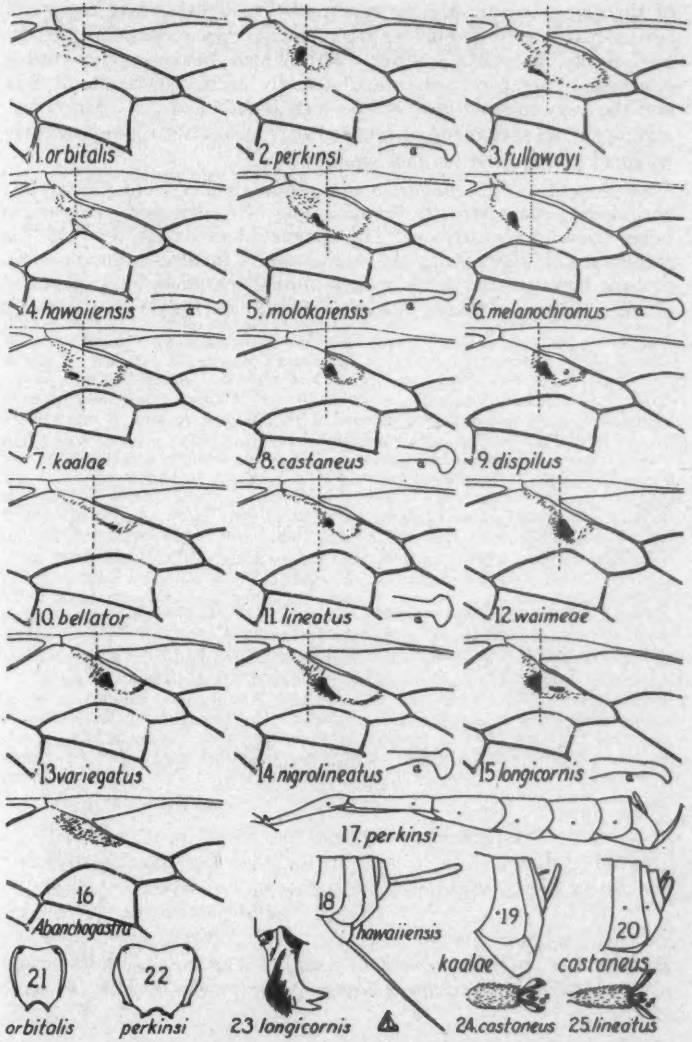
EXPLANATION OF PLATE II

Portions of forewings, aedeagi, and other details of Hawaiian species of *Enicospilus* and *Abanchogastra*.

Fig. 1. *Enicospilus orbitalis* (Ashmead). Portion of wing.
Fig. 2. *Enicospilus perkinsi*, n. sp. Portion of wing and (a) aedeagus.
Fig. 3. *Enicospilus fullawayi*, n. sp. Portion of wing.
Fig. 4. *Enicospilus hawaiiensis* (Ashmead). Portion of wing and (a) aedeagus.
Fig. 5. *Enicospilus molokaiensis* (Ashmead). Portion of wing and (a) aedeagus.
Fig. 6. *Enicospilus melanochromus* Perkins. Portion of wing and (a) aedeagus.
Fig. 7. *Enicospilus kaalae* Ashmead. Portion of wing.
Fig. 8. *Enicospilus castaneus* Ashmead. Portion of wing and (a) aedeagus.
Fig. 9. *Enicospilus dispilus* Perkins. Portion of wing.
Fig. 10. *Enicospilus bellator* Perkins. Portion of wing.
Fig. 11. *Enicospilus lineatus* (Cameron). Portion of wing and (a) aedeagus.
Fig. 12. *Enicospilus waimeae* Ashmead. Portion of wing.
Fig. 13. *Enicospilus variegatus* Ashmead. Portion of wing.
Fig. 14. *Enicospilus nigrolineatus* Ashmead. Portion of wing and (a) aedeagus.
Fig. 15. *Enicospilus longicornis* Ashmead. Portion of wing and (a) aedeagus.
Fig. 16. *Abanchogastra hawaiiensis* Ashmead. Portion of wing.
Fig. 17. *Enicospilus perkinsi*, n. sp. Abdomen of female.
Fig. 18. *Enicospilus hawaiiensis* (Ashmead). Apex of abdomen of female.
Fig. 19. *Enicospilus kaalae* Ashmead. Apex of abdomen of female.
Fig. 20. *Enicospilus castaneus* Ashmead. Apex of abdomen of female.
Fig. 21. *Enicospilus perkinsi*, n. sp. Propodeum and metapleura.
Fig. 22. *Enicospilus orbitalis* (Ashmead). Propodeum and metapleura.
Fig. 23. *Enicospilus longicornis* Ashmead. Mandible.
Fig. 24. *Enicospilus castaneus* Ashmead. Apical joint of front tarsus of male.
Fig. 25. *Enicospilus lineatus* (Cameron). Apical joint of front tarsus of male.


1. orbitalis
2. perkinsi
3. fullawayi
4. hawaiiensis
5. molokaiensis
6. melanochromus
7. kaalae
8. castaneus
9. dispilus
10. bellator
11. lineatus
12. waimeae
13. variegatus
14. nigrolineatus
15. longicornis
16
Abanchogastra
17. perkinsi
18
hawaiiensis
19
kaalae
20
castaneus
21
orbitalis
22
perkinsi
23 longicornis
24. castaneus
25. lineatus

the inclusion of *henshawi* in *Enicospilus,* but, except for the lack of the alar sclerome, the specimen labelled *henshawi* by Ashmead agrees better with the description than do specimens identified by Perkins as *lineatus* Cameron (with which Perkins synonymizes *henshawi*), notably in the very strongly arched discocubital vein and the very narrow base of the second discoidal cell. Moreover, among the 26 specimens of *lineatus* that I have seen none is nearly so small as the type of *henshawi.*

I recognize *Abanchogastra* as a genus distinct from *Enicospilus* entirely on characters of venation (fig. 16), the body characters being those of *Enicospilus.* The complete lack of the fenestra, the rather broad stigma with the radius much farther from the base, and the reclivous nervellus broken at or above the middle, features characteristic of *Ophion,* appear sufficient for generic distinction.

Description of a New Mymarid Egg Parasite Collected at Los Mochis, Sinaloa, Mexico

BY DAVID T. FULLAWAY

Board of Agriculture and Forestry

(Presented at the meeting of November 8, 1943)

Anagrus yawi, n. sp.

Female with the thorax reddish except the mesothoracic scutum which is black. Head and abdomen blackish. Legs and basal three antennal segments yellowish; antennae beyond third segment fuscous. Wings hyaline; slightly dusky at base beneath the short marginal vein. Antennae somewhat longer than the body, scape expanded, fusiform, nearly twice as long as the pedicel, which is obovate; 1st funicle joint slender, a little longer than wide; funicle joints 2 to 6 subequal in length and about three times as long as wide, successively increasing very slightly in length as well as width; club stout, nearly three times as long as wide, nearly as long as funicle joints 5 and 6 combined and twice as wide. Forewing extending more than a third its length beyond the apex of the abdomen, more than six times as long as its greatest width, not including marginal fringe, which is as long as, or (on posterior margin near apex) longer than greatest width; discal cilia rather sparse and generally confined to three longitudinal lines of short hairs, two in the anterior half of the wing (one of these extended by five hairs almost to base of marginal vein; outwardly beyond widest part of wing spread out into additional but somewhat irregular lines) and one in the posterior half along the margin. Hind wings narrow with fringe on anterior margin less than half as long as that on posterior margin, and no discal ciliation except along the margins. Tarsal joints sub-equal. Abdomen about as long as the thorax, ovate to securiform, the hypopygium extending a little beyond the apex of last tergite.

Male agreeing with the female except in the secondary sexual characters about as follows: Antennae nearly twice as long as the body, very slender, 13-jointed, scape short and thick, approximately twice as long as wide, pedicel shorter and narrower, about three times as long as wide, funicle joints subequal and each about four times as long as wide. Abdomen hardly as long as thorax.

Length about 0.5 mm.

Described from numerous specimens prepared and mounted on slides in balsam and collected at Los Mochis, Sinaloa, Mexico, where they were found emerging from the eggs of the mirid bug *Pycnoderes quadrimaculatus* Guerin.

Named for Fred L. Yaw, of Los Mochis, Sinaloa, Mexico, whose kind assistance contributed to the discovery of this valuable parasite, and to its eventual introduction and establishment in Hawaii.

Types in the collection of the Hawaiian Entomological Society, Honolulu.

Insects of Vegetable Crops in Hawaii Today

BY F. G. HOLDAWAY

Entomologist, Hawaii Agricultural Experiment Station

(Presidential address, delivered December 13, 1943)

Two years ago, almost to the day, Hawaii was attacked by Japan and the United States became actively involved in the war. The events which followed have forced on Hawaii the need for producing more of its food than it produced formerly—a necessity which has been accentuated by the increase in population through the influx of defense workers and service personnel. Because of these events, and because I have been activly engaged in advancing our knowledge of insects of food crops and their control, and in disseminating that knowledge to the public, it is perhaps natural that I should select for review "The present situation regarding insects of vegetable crops in Hawaii."

The maritime strike of 1936 demonstrated the undue extent to which Hawaii was dependent on outside sources of foods. As a result the Hawaii Experiment Station at the University made a move to re-establish the positions of Plant Pathologist and Entomologist, positions which had been allowed to lapse for many years. In 1937 I arrived in Honolulu to re-establish an Entomology Department in the Station. The Station had been without an entomologist for twenty-two years. I was charged especially with carrying on research on the insects of vegetable crops.

In the twenty-two years which had passed since Mr. Fullaway left the Experiment Station to accept a position with the Board of Agriculture and Forestry and the position of entomologist lapsed, there had been many changes. Agriculture had changed. Technical work on sugar cane was already being handled by a separate experiment station. The needs of the pineapple industry were being handled by a separate experiment station with its own entomology department. Many of the crops that the Territory had been interested in during the first fifteen years of the present century had dropped out of the agricultural picture; others were entering it. New insect problems were arising.

The first step of the new Entomology Department was, then, to determine what insect problems it would be called on to handle. True, I had been provided with a list of some twenty odd important insect problems needing attention; and the entomologists of the respective organizations of the Territory had been making observa-

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tions of considerable value over the years. But this information was inadequate. Observations soon revealed that many important problems were not on the list I had been given; other observations revealed that several insects we encountered had not even been recorded in the Territory; other insects had been recorded but were not regarded as economically important.

I shall, therefore, discuss briefly some of the aspects of this changing scene, especially as it concerns the insects, and, in particular, the new immigrants and those insects formerly of little consequence but which have become important.

The Changing Scene

Changing Agriculture

While observations made prior to the beginning of the present century have an important bearing on the field of economic entomology, applied entomology in Hawaii may be said to date from the appointment on July 1, 1902 of D. L. Van Dine to the position of entomologist in the Hawaii Agricultural Experiment Station, which at that time was supported wholly by Federal funds.

On May 18, 1903 the Division of Entomology of the newly created Board of Commissioners of Agriculture and Forestry was organized.

In August 1904 the Division of Entomology of the Experiment Station of the Hawaiian Sugar Planters' Association was created.

On December 15, 1904 a meeting was held to consider the advisability of forming a Hawaiian Entomological Society and on January 26, 1905 the new society held its first meeting. (It is of interest to note in passing that Mr. O. H. Swezey who is still one of the most active members of the Society and also the Editor of the Proceedings was present at those first two meetings and was elected a member of the first executive committee. He is the only one of the original members who is still active and regularly attends the Society's meetings.)

Thus four important entomological events took place during the four years 1902-1905 inclusive.

An examination of Van Dine's early reports gives an interesting picture of the agriculture of the day and the problems the entomologist was called on to handle. His partial lists of crops in the reports of the entomologist for 1904 (32), 1905 (33), 1906 (34), and 1907 (35) were revised and summarized in his report for 1908 (36) as "A revised list of the injurious insects of Hawaii." His list included the following twenty-six crops: Sugar, rice, coffee, taro, sisal, tobacco, cotton, cassava, sweet potato, corn, cabbage, melon, pineapple, citrus, mango, banana, avocado, fig, grape, apple, peach, guava, mulberry, strawberry, sour sop, coconut, and ornamental

and forest trees. It includes many field crops, some fruit trees and some small fruits, but only three vegetable crops. If one includes corn, which was in any case no doubt field corn, there are four vegetables. In the partial list for 1904 (32) six vegetable crops were mentioned—cucurbits, bean, tomato, corn, cabbage, and potato, and seven vegetable insects were cited.

In the report of the entomologist for 1913 by D. T. Fullaway (2) who had succeeded Van Dine in 1909, the following fourteen particular vegetable crops were mentioned: cabbage, turnip, radish, celery, parsley, carrot, potato, tomato, eggplant, cucumber, pumpkin, squash, spinach, and onion. The insects which attacked them were also given. It would appear from this longer list that vegetables were receiving greater attention. Moreover since many of the larger field crops and some of the fruits mentioned in Van Dine's earlier lists received little attention, it would appear that they were passing from the agricultural picture.

By 1915 Mr. Fullaway had resigned to accept his position with the Board of Agriculture and Forestry, and, apart from the observations and other intermittent work carried on by the entomologists of the various institutions of the Territory, research on vegetable insects as the special responsibility of an entomologist or a group of entomologists ceased until 1937 when the entomology department was re-established in the Hawaii Agricultural Experiment Station.

In the years just prior to 1937 interest in vegetable production had begun to increase. Head cabbage, Chinese cabbage, and other related crops were grown to an increasing extent, and for considerable periods supplied completely the needs of the Territory for these crops. Green bean production increased so that just before the war the Territory was producing all the beans it required. Interest in tomato production was increasing. There was also renewed interest in Irish potato production.

During the defense emergency, 1939-41, interest in sweetpotato and lima bean increased, and, following our entry into the war there was a further increase in interest in Irish potato. Through the stimulus to Victory gardens, interest in the so-called "small crops" increased.

Thus even during the past few years the agricultural picture has changed and is still changing. It is necessary to be aware of these developments since they often involve changes in the relative importance of insects too.

Vegetable insects new to Hawaii

During the years just prior to 1937 the following eight vegetable insects had been found in Hawaii for the first time:

Bean-pod borer, *Maruca testulalis* (Geyer) in 1922 by Swezey ..... [Swezey (28)]

Tomato bug *Cyrtopeltis varians* (Distant) in 1924 by Swezey ..... [Swezey (29)]
Tomato pinworm, *Keiferia lycopersicella* (Busck) in 1925 by Swezey..... [Swezey (31)]
Vegetable weevil, *Listroderes obliquus* Klug in 1926 by Swezey ..... [Swezey (30)]
Bean capsid, *Pycnoderes quadrimaculatus* Guerin-Meneville in 1929 by Illingworth..... [Illingworth (20)]
Pepper weevil, *Anthonomus eugenii* Cano in 1933 by Fullaway ..... [Fullaway (3)]
Datura beetle, *Lema trilineata californica* Schaeffer in 1933 (?) by Krauss..... [Krauss (21)]
Chrysanthemum thrips, *Thrips nigropilosus* Uzel in 1935 by Sakimura..... [Sakimura (26)]

Since 1937 the following thirteen additional insects (and mites) have been found:

Aphis rumicis Linnaeus in 1938 by Lucas..... [Look and McAfee (23)]
Cavariella capreae (Fabricius) in 1939 by Marvin..... [Look and McAfee (23)]
Onion moth, *Acrolepia assectella* Zeller in 1939 by Holdaway (collected by Furuya)..... [Holdaway (14)]
Turnip aphid, *Rhopalosiphum pseudobrassicae* (Davis) in 1939 by Look..... [Holdaway, Look and Lucas (19)]
Cabbage looper, *Autographa brassicae* (Riley) in 1939 by Lucas (collected by Akana)..... [Holdaway, Look and Lucas (19)]
Onion aphid, *Micromyzus formosanus* (Takahashi) in 1939 by Look..... [Holdaway, Look and Lucas (19)]
Dendrothripoides ipomeae Bagnall in 1940 by Bianchi..... [Bianchi (1)]
Celery aphid, *Brachycolus heraclei* Takahashi in 1940 by Holdaway ..... [Look and McAfee (23)]
Myzus convolvuli (Kaltenbach) in 1941 by Lucas..... [Look and McAfee (23)]
Tomato russet mite, *Phyllocoptes destructor* Keifer in 1942 by Holdaway..... [Holdaway (13)]
Rusty-banded aphid, *Aphis ferruginea-striata* Essig in 1942 by Zimmerman..... [Zimmerman (37)]
Frankliniella sp. in 1942 by Nishida..... [Nishida (25)]
Bean thrips, *Hercothrips fasciatus* (Pergande) in 1943 by Krauss ..... [Krauss (22)][1]

Thus a number of new economic insects had entered the scene just prior to our embarking on a detailed study of vegetable insects, while several more have been recorded since we began our work.

[1] In a subsequent survey Krauss was unable to recover this insect (26).

The situation has led me to inquire "What has been happening over a longer period of time?" It has been found that since 1880 new economic insect immigrants have continually been recorded in Hawaii. Prior to 1937 the greatest number of new records of vegetable insects per five-year period, eleven species, occurred during 1905-1909 inclusive. This was the period immediately following the important developments in entomology which have already been mentioned. All these developments resulted in an increase in the number of entomological observers in the Territory and an increase in interest in matters entomological.

From 1910 onward there continued to be new records of insect immigrants but the rate of discovery fell off considerably. There was only one new record for the five-year period 1910-1914 inclusive. In the period 1915-1919 there were three new records and for the period 1920-1924 three more. One is led to the conclusion that either the new vegetable insect immigrants had to a large extent been discovered or new immigrants were not entering the Territory as frequently. Possibly both factors were operating.

What then is the explanation for the increase in records over recent years? No doubt the increased attention to insects of vegetables in the Hawaii Experiment Station has played an important part for the majority of the records are by the new group of workers. But not all the records have been made by this new group. I have concluded that the new records are in part due to the increase in vegetable importations over the past fifteen years. If this conclusion is correct, and it is supported by Mr. Fullaway, who has had more opportunity for observing the importations of vegetables than any other entomologist in the Territory, what of the future? Must we expect even more introductions? Can the quarantine service succeed in blocking them?

New problems from insects already present in the Territory

I have mentioned the new immigrant species of vegetable insects which have entered the Territory in recent years. Some of these have already made their presence felt in the crop production picture. Cabbage looper is capable of considerable injury to head cabbage at low elevations. Onion aphid, while, in general, not abundant, is also capable of serious injury when infestations are allowed to go unchecked. Turnip aphid, also, has shown, by the injury it has caused to some crops, that it is a potentially important insect. Celery aphid is the most important insect of celery today. It is capable of devastating injury if uncontrolled. We have recorded it on Oahu, Maui, and Hawaii. Tomato russet mite, which is now fairly widespread on Oahu and present also on Maui and Kauai, is capable of

complete destruction of plants if it is not controlled. All these insects must be reckoned with in vegetable production in the future.

There are other insects, however, that have been present in the Territory some time, but which have become more important through changes in the agriculture of the Territory or for other reasons not yet fully understood. Greenhouse white fly, *Trialeurodes vaporariorum* (Westw.) present in the Territory for over half a century, has become a limiting factor to green bean production in the Waianae section of Oahu—a section which formerly produced up to 58 per cent of the green beans grown on this island. (10) (12) (15). Fire ant, *Solenopsis geminata rufa* (Jerdon), which formerly was an occasional pest of the roots and stems of tomato plants, cucumber plants, and eggplants, (18) has become more important because of the increased production of these crops at the low elevations where this ant is common. Loss of crops of carrot, beet, and chard in the cotyledon stage has been shown to be due to garden flea-hopper, *Leucopoecila albofasciata* Reut. (11). This is another problem whose severity is increased by the increasing vegetable production. Prior to 1941 tomato bug was not a particularly important insect of tomato because conditions favorable to the bug were unfavorable to tomato production with the varieties that were then available. In 1941 Dr. Frazier found that "Bounty," one of his new introductions, was particularly suitable for growth under our low elevation, high temperature conditions. These were the conditions under which tomato production was difficult with the varieties formerly available. Following the introduction of "Bounty," commercial tomato production in the Territory during the six-month period of summer months, June-November, inclusive, has increased 79 per cent in two years. On Oahu, where the summer increase is most marked, production of tomatoes has advanced 264 per cent. Through this change in production of tomatoes during summer at low elevations tomato bug has now become an important factor in the growing of tomatoes (12).

The Insects of Vegetables Today

As a result of the new insect immigrants and the increased importance of many other species, the insects of vegetables today are different from those recorded at any other time in the history of the Territory.

In an insect control program it is necessary first to determine which species of insects are responsible for injury to the respective vegetables and when, where, or under what conditions injury occurs. Hawaii has no winter to speak of. Thus the low temperatures so characteristic of continental areas are not available to reduce the abundance of the crop insects. Nevertheless there are marked relationships between certain insects and climatological

zones or physiographic areas. Some are insects of low elevation; some are insects of high elevation; some are insects of the summer; some are most abundant in regions of intermediate rainfall; some are apparently little affected by climatic conditions or physiography but are affected more by abundance of host crops and especially by the sequence of crop hosts than by any other factor. Further it is necessary to determine the *group* of insects which occurs on each crop and which of them are of major importance. When the major problems have been determined, experimental work on the control of the major insects can be devised with due regard for the possible presence of other insects or diseases.

A considerable amount of knowledge has been built up on the insects of the respective vegetables. While much more work remains to be done, and while further observations will undoubtedly result in some modification of ideas held at the present time, sufficient information has been secured for the practical needs of the moment.

In the accompanying table I have listed the insects of 30 vegetables. They are grouped as major insects, submajor insects, occasional pests, and minor insects.

Major insects are those which cause major economic loss of the crop attacked unless they are controlled. They are, in general, widespread in their distribution. They are not necessarily present on the crop at all times and in all places; some are restricted as to vegetation zone and season.

Submajor insects are those insects which may cause major economic loss at times, but less severely, less often, or to a less widespread extent than the major insects.

Occasional pests are those minor insects which occasionally are present in sufficient numbers to cause marked injury.

Minor insects are those which may feed freely on or reproduce on the host crop but which do not cause marked injury to the crop.

In the observations which have been made to date some crops have received more attention than others and a more complete picture of the insects of such crops has thus been secured. Although the amount of time given to the respective crop has varied, it is probable that further observations will not lead to any marked changes in designation of the major and the submajor insects.

You will observe from the table that there is a comparatively small number of major insects for each crop—sometimes none—but a larger number of the group I have designated as "submajor." There is a relatively large number of the minor insects which occasionally are present in numbers sufficiently large to cause injury. The list of insects designated as minor is approximately the same size as that of the occasional pests. From the practical standpoint the major and submajor insects are of most consequence. Many of these, however, are not present for considerable periods.

Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii.[1]

Crop	Major Insects[1]	Submajor Pests[1]	Occasional Pests[1]	Minor Insects[1]
Bean (green)	*Adoretus sinicus* *Aphis medicaginis* *Trialeurodes vaporariorum*‡ *Empoasca solana**	*Pycnoderes quadrimaculatus** *Hemitarsonemus latus** *Tetranychus* sp.* *Plusia chalcites*	*Heliothis armigera* *Veronicella leydigi* *Liriomyza pusilla* *Frankliniella* sp. *Stictocephala festina* *Solenopsis geminata** *Dacus cucurbitae*	*Aphis gossypii* *Cosmolyce boetica* *Phenacoccus gossypii* *Atractomorpha ambigua* *Cyrtopeltis varians* *Myzus persicae*
Bean (lima)	*Maruca testulalis* *Aphis medicaginis*	*Pycnoderes quadrimaculatus** Tetranychid sp.*	*Stictocephala festina* *Frankliniella* sp.* *Plusia chalcites*	*Empoasca solana** *Aphis rumicis*
Beet	*Hymenia recurvalis** *Hemitarsonemus latus**	*Leucopoecila albofasciata*§ *Empoasca solana** *Laphygma exigua*	*Nysius nigriscutellatus**	*Myzus persicae* *Plusia chalcites*
Broccoli	*Pieris rapae* *Hellula undalis**	*Adoretus sinicus* *Autographa brassicae* *Agrotis ypsilon* *Brevicoryne brassicae* *Myzus persicae* *Murgantia histrionica* *Eulota similaris*¶ *Veronicella leydigi*¶	*Laphygma exigua* *Thrips tabaci* *Plutella maculipennis**	*Laphygma exigua* *Liriomyza pusilla*
Cabbage (Chinese)	*Hellula undalis**	*Adoretus sinicus* *Eulota similaris*¶ *Pieris rapae* *Peridroma margaritosa* *Rhopalosiphum pseudobrassicae* *Myzus persicae*	*Liriomyza pusilla* *Nysius nemorivagus*† (Hawaii) *Listroderes obliquus*† (Maui, Hawaii) *Murgantia histrionica*	*Brevicoryne brassicae* *Laphygma exigua*

Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii.[1]—Continued.

Crop	Major Insects[1]	Submajor Pests[1]	Occasional Pests[1]	Minor Insects[1]
Cabbage (head)	*Pieris rapae* *Hellula undalis**	*Autographa brassicae* *Agrotis ypsilon* *Eulota similaris*¶ *Veronicella leydigi*¶ *Brevicoryne brassicae* *Myzus persicae* *Murgantia histrionica* *Peridroma margaritosa*	*Atractomorpha ambigua* *Plutella maculipennis** *Listroderes obliquus*† (Maui, Hawaii) *Laphygma exigua* *Thrips tabaci* *Heliothis armigera* *Plusia chalcites*	*Liriomyza pusilla* Earth worm sp.
Carrot		*Agrotis ypsilon* *Listroderes obliquus*† (Hawaii) *Brevicoryne brassicae* *Leucopoecila albofasciata*§	Tetranychid sp. *Pseudococcus brevipes* *Aphis ferruginea-striata* *Brachycolus heraclei*	*Laphygma exigua* *Atractomorpha ambigua*
Celery	*Brachycolus heraclei*	*Plusia chalcites*	*Pseudococcus brevipes* Tetranychid sp. *Coccus viridis* *Veronicella leydigi* *Thrips tabaci*	*Aphis gossypii* *Liriomyza pusilla* *Agromyza virens*
Chard	*Hymenia recurvalis** *Hemitarsonemus latus**			*Empoasca solana** *Nysius nigriscutellatus*
Chinese spinach		*Hymenia recurvalis**	*Agrotis ypsilon* *Empoasca solana** *Leucopoecila albofasciata*	*Myzus persicae* *Nysius nigriscutellatus* *Laphygma exigua*

[1] Including Acarina, Mollusca and Annulata.
* At low elevations.
§ At onset of dry season.
¶ During wet season.
† At higher elevations.
‡ In Waianae and Lualualei, Oahu and certain other isolated places.

Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii.[1]—Continued.

Crop	Major Insects[1]	Submajor Pests[1]	Occasional Pests[1]	Minor Insects[1]
Corn (sweet)	*Heliothis armigera* *Peregrinus maidis** *Aphis maidis*	*Adoretus sinicus* *Laphygma exempta* *Agrotis ypsilon*		*Amorbia emigratella* *Atractomorpha ambigua* *Carpophilus hemipterus* *Carpophilus humeralis* *Plusia chalcites*
Cowpea	*Empoasca solana**	*Aphis medicaginis*	*Maruca testulalis* *Hemitarsonemus latus**	*Heliothis armigera*
Cucumber	*Dacus cucurbitae* *Aphis gossypii*	*Apomecyna pertigera* *Empoasca solana** *Pycnoderes quadrimaculatus**	*Solenopsis geminata** *Nysius nemorivagus*† (Hawaii) Collembola sp. (Hawaii)	*Thrips tabaci*
Daikon	*Hellula undalis**	*Rhopalosiphum pseudobrassicae*	*Liriomyza pusilla* *Murgantia histrionica* *Listroderes obliquus* *Pseudococcus brevipes*	*Myzus persicae*
Eggplant	*Adoretus sinicus** Tetranychid sp.* *Hemitarsonemus latus**	*Epitrix parvula** *Aphis gossypii* *Saissetia nigra* *Anthonomus eugenii* *Contarinia lycopersici** *Frankliniella* sp.*	*Thecla echion* *Myzus persicae* *Agrotis ypsilon* *Gnorimoschema operculella* *Solenopsis geminata** *Icerya purchasi* *Phenacoccus gossypii* *Lema trilineata californica* *Trialeurodes vaporariorum*	*Heliothis armigera* *Amorbia emigratella* *Plusia chalcites* *Empoasca solana* *Macrosiphum solanifolii* *Atractomorpha ambigua*
Lettuce		*Plusia chalcites* *Empoasca solana** *Thrips tabaci** *Thrips nigropilosus*	*Pycnoderes quadrimaculatus** *Listroderes obliquus*† (Hawaii) *Heliothis armigera*	*Liriomyza pusilla* *Autographa brassicae* *Dendrothripoides ipomeae* *Laphygma exigua*

Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii.[1]—Continued.

Crop	Major Insects[1]	Submajor Pests[1]	Occasional Pests[1]	Minor Insects[1]
Lettuce (Cont'd)		*Agrotis ypsilon* *Eulota similaris*¶ *Veronicella leydigi*¶	*Trialeurodes vaporariorum*	*Macrosiphum solanifolii*
Mustard	*Hellula undalis**	*Myzus persicae*	*Pycnoderes quadrimaculatus** *Hemitarsonemus latus** *Liriomyza pusilla*	*Atractomorpha ambigua*
New Zealand spinach		*Hymenia recurvalis**	Tetranychid sp.*	
Okra	*Aphis gossypii*	*Adoretus sinicus*	Tetranychid sp.	*Empoasca solana** *Saissetia nigra* *Pycnoderes quadrimaculatus** *Frankliniella* sp.*
Onion		*Laphygma exigua* *Thrips tabaci* *Micromyzus formosanus*	*Taeniothrips alliorum*	*Acrolepia assectella* *Atractomorpha ambigua*
Parsley			*Plusia chalcites* Tetranychid sp.* *Brachycolus heraclei*	*Atractomorpha ambigua*
Pepper	*Anthonomus eugenii* *Hemitarsonemus latus**	*Laphygma exigua* *Aphis gossypii* *Contarinia lycopersici** *Frankliniella* sp.* *Myzus persicae*	*Ceratitis capitata*	*Heliothis armigera* *Thecla echion* *Phenacoccus gossypii* *Saissetia nigra*

[1] Including Acarina, Mollusca and Annulata.
* At low elevations.
§ At onset of dry season.
¶ During wet season.
† At higher elevations.
‡ In Waianae and Lualualei, Oahu and certain other isolated places.

Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii.[1]—Continued.

Crop	Major Insects[1]	Submajor Pests[1]	Occasional Pests[1]	Minor Insects[1]
Potato	*Gnorimoschema operculella**	*Plusia chalcites* *Laphygma exigua* *Macrosiphum solanifolii* *Agrotis ypsilon*	*Aphis gossypii* *Myzus persicae* *Empoasca solana** *Hemitarsonemus latus** *Nysius nigriscutellatus* *Nysius nemorivagus*† *Peridroma margaritosa* *Epitrix parvula* *Listroderes obliquus*† (Maui, Hawaii)	*Thrips tabaci* *Atractomorpha ambigua* *Heliothis armigera* *Laphygma exempta** Aleyrodid sp. *Cyrtopeltis varians* *Pseudococcus longispinus* *Lema trilineata californica* *Thecla echion*
Radish	*Hellula undalis**		*Listroderes obliquus*† (Maui, Hawaii) *Rhopalosiphum pseudobrassicae*	
Soybean		*Adoretus sinicus*	*Hemitarsonemus latus** *Laphygma exigua*	*Icerya purchasi* *Aphis medicaginis*
Spinach		*Hymenia recurvalis*	*Plusia chalcites* *Empoasca solana** *Hemitarsonemus latus**	*Myzus persicae* *Aphis gossypii*
Sweetpotato	*Bedellia orchilella* *Omphisa anastomosalis* *Euscepes postfasciatus*	*Cylas formicarius* *Herse cingulata*	*Adoretus sinicus* *Pycnoderes quadrimaculatus** *Plusia chalcites*	*Laphygma exigua* *Dendrothripoides ipomeae* *Aloha ipomoea* *Atractomorpha ambigua* *Aphis gossypii* Tetranychid sp.* *Hemitarsonemus latus** *Empoasca solana** *Aphis medicaginis*

Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii.[1]—Continued.

Crop	Major Insects[1]	Submajor Pests[1]	Occasional Pests[1]	Major Insects[1]
Sweetpotato (Cont'd)				*Macrosiphum solanifolii* *Myzus persicae*
Tahitian spinach			*Pentalonia nigronervosa* *Aphis gossypii*	Tetranychid sp. *Rhopalosiphum nymphaeae*
Tomato	*Heliothis armigera*. *Dacus cucurbitae* *Cyrtopeltis varians** *Phyllocoptes destructor**	*Keiferia lycopersicella** *Epitrix parvula** *Macrosiphum solanifolii* *Aphis gossypii* *Hemitarsonemus latus** *Contarinia lycopersici** *Frankliniella* sp.*	*Gnorimoschema operculella* *Laphygma exempta* *Laphygma exigua* *Trialeurodes vaporariorum*‡ *Solenopsis geminata** *Plusia chalcites* *Agrotis ypsilon* Tenebrionid sp.	*Thrips tabaci* (important as a vector of spotted wilt) *Atractomorpha ambigua*
Turnip	*Hellula undalis**		*Listroderes obliquus*† (Maui, Hawaii) *Agrotis ypsilon* *Myzus persicae*	

[1] Including Acarina, Mollusca and Annulata.
* At low elevations.
§ At onset of dry season.
¶ During wet season.
† At higher elevations.
‡ In Waianae and Lualualei, Oahu and certain other isolated places.

The Control of Major Insects of Vegetable Crops in Hawaii

I have indicated earlier that for 22 years it was no one's special responsibility to work on vegetable insects. It was not surprising, therefore, to find from the surveys which I made during 1938 and 1939 of the literature and of conditions in the field that there was very little organized knowledge available on the vegetable insects, while the control of the insects was almost non-existent. Some attention had been given to the biological control of a few of the vegetable insects by entomologists of the Board of Agriculture and Forestry. But this line of attack, which has been so successful against several of the important agricultural insects of Hawaii, had not received the attention it deserves. Materials for chemical control were little known and only a few were available.

Nicotine sulphate, Paris green, arsenate of lead and sulphur were available in small quantities. Nicotine sulphate was not used to any great extent against insects for which it is suitable. Paris green was used mainly for cutworm baits, and occasionally as a spray on Irish potatoes. Arsenate of lead was used very little. Use of sulphur was restricted almost exclusively to the most obvious red spider infestations; it was not used as commonly or as freely as it could have been.

Pyrethrum was available in comparatively small quantities as a Japanese product known as "Imazu." The pyrethrin content of this product was not known. Moreover it was commonly used as an all-purpose spray, often wastefully and with little result. Indeed there was little likelihood of its being successful against many of the problems for which it was used. Another pyrethrum product, "Pyrocide," had just been introduced to the Territory in small quantities.

No cryolite was available. There was no calcium arsenate and no raw rotenone powder. A small quantity of a rotenone powder had been on the market at one time a few years previously but supplies had not been continued. A commercial preparation of rotenone and pyrethrum, "Foliafume", had just appeared on the local market. While it was an effective preparation for certain problems, and a very suitable preparation for small home gardens, it was comparatively expensive for use in commercial production. Moreover, as with "Imazu," it was often used as an all-purpose spray against insects not likely to be controlled effectively by it. Most of the insecticides available were small packaged preparations put out by one or two west coast insecticide firms. Many of these prepared products were mixtures put up for certain combinations of problems present in various sections of the mainland and not necessarily of any particular use for Hawaii.

The lack of insecticides and the small use to which those available were put were no doubt due to the fact that until our own

experimental work began in 1938 there was no satisfactory basis for recommendations, importation, distribution and use of the respective insecticides.

The situation is well illustrated by the following facts. In 1913, Fullaway (2) wrote regarding cabbage webworm, even then considered to be a serious pest of cabbages and related plants, "Little can be suggested in the way of remedies as all the insecticides experimented with by Marsh failed to give appreciable results." In 1938, twenty-five years later, there were still no remedies available; moreover the vegetable growers still referred to the occurrence of cabbage webworm as due to the presence of a "sick wind" regarding which nothing could be done!

Today the ten or twelve crops which are severely attacked by cabbage webworm can be grown and are being grown satisfactorily without fear of the "sick wind," since we have demonstrated experimentally that rotenone dust and cryolite dust will control cabbage webworm satisfactorily.

In the table which I have just presented I have given part of the information necessary to a satisfactory program of research on control. Until the major and submajor insects have been determined and the relative importance of each insect on each crop has been evaluated, a program of research is likely to result in considerable loss of time and a good deal of misdirected effort. From the evidence on major and submajor insects it is possible to determine which are the particular insects calling for special experimentation and which are the "Key" problems on each crop. Moreover in planning a control program it is necessary to know something of the disease problems likely to be present on the respective crops, and whether any of them are also "Key" problems which must be reckoned with in the insect control program. Further it is also necessary to know the relative importance of "Key" insect problems and "Key" disease problems.

A few particular examples will make my point clearer.

Head cabbage has no regular major disease problems comparable in power to destroy a crop with the insect problems.[1] Thus experimentation could proceed on the insect problems with little or no thought to the possible disease problems. Moreover it has been determined that the key problems on this crop are cabbage webworm and cabbage butterfly. Further, the relative importance of these two key problems will depend on the locality and the season; at elevations below 1,000 feet, and especially in the summer months, cabbage webworm will be the more important key problem followed

[1] This was the situation at the time our work on the control of cabbage insects began. However, black rot, a bacterial disease, is now quite common in Hawaii, and causing considerable damage in some sections. Since this disease is bacterial and not likely to be affected by chemical control measures applied to the plant, the situation regarding the insects remains essentially as it was before black rot became prevalent.

by cabbage butterfly in a secondary place. At elevations above 1,000 feet cabbage webworm will be negligible and cabbage butterfly will be the key problem. At elevations of 4,000 feet cutworms are relatively important but do not rank as key problems.

Tomato has a number of insect problems from which it may suffer considerably, and, under humid conditions, has certain fungus diseases also. (We can omit the virus diseases from our present discussion since in the light of present knowledge they are not likely to be controlled or prevented by a program of chemical control in the near future.) Until the key problems are determined the control program may be aimed at any of eighteen species mentioned in the first three categories of Table 1 and capable of serious injury to the crop.

With the determination of the major insects and evaluation of corn earworm and melonfly as key problems the research program has been directed into these two main channels with the fungus diseases subsidiary key problems under wet conditions and the other insect problems subsidiary to the key problems. When control of the key insects is secured, many of the subsidiary problems are taken care of automatically by the control measures for the key problem while control of other subsidiary problems is incorporated with the measures for the key insects.

Celery is an example of yet another type of crop. On this crop the key problems are fungus diseases. Even though there are on celery two important insects, celery aphid and garden looper, control measures for these two insects are secondary and incorporated with those aimed at the diseases.

Study of the vegetable insects and research on their control has followed two governing principles, first the importance of the crop to the community and second the determination of the key problems on the important crops. Before the defense emergency the most important vegetable crops were tomato, head cabbage, green bean, and Irish potato. During the emergency period sweetpotato, carrot, cowpea, Chinese cabbage, lima bean, and sweet corn were added to the list of important crops. Following our entry into the war, lettuce, radish, chard, beets, celery, and other miscellaneous vegetables have been added because it became necessary for the Territory to produce more of its own perishable greens and, moreover, it became necessary for the home gardener to contribute his effort.

When possible we have utilized the biological control method in collaboration with entomologists of the Board of Agriculture and Forestry. But we have not had time, staff, or funds adequate to the needs of a satisfactory biological control project. It has been necessary to secure some measure of control in the minimum of time and we have secured it, in the main, by means of chemicals.

The results of much of the experimental work to date on the control of major insects have already been summarized in various progress notes, annual reports, and circulars of the Hawaii Agricultural Experiment Station and the Extension Service, and in papers presented before the Hawaiian Academy of Science (4) (5) (6) (7) (8) (9) (12) (15) (16) (17) (19). I shall not spend time here to discuss the experimental work in detail but shall restrict myself to mentioning briefly some of the more outstanding results.

Tomato

In 1937 the opinion was commonly held by agriculturists that tomato bug, *Cyrtopeltis varians,* was likely to be a limiting factor to tomato production in Hawaii. In the years immediately following the establishment of the Entomology Department we were able to show that tomato bug is primarily an insect of low elevations and especially of the summer months. With the varieties of tomato then available, satisfactory commercial production of tomatoes was apparently not possible during the summer months at low elevations; the crop was commonly grown at elevations of 1,000 to 2,000 feet, and when grown at low elevations was produced in the winter months only.

With such a system of tomato production, tomato bug was not a serious problem because tomatoes were produced mainly in regions where the importance of the bug was negligible.

Up to 1939, 50 per cent of the tomato crop was commonly lost through corn earworm attack in spite of attempts to control it with sprays. In 1940 we established a control for corn earworm by means of cryolite and worked out combination treatments for this insect and others together with a control for fungus disease.

Corn earworm on tomato is no longer a nightmare to the farmer. It is now controllable to an extent approaching 100 per cent by means of cryolite, provided timing of the applications is satisfactory and application is thorough.

I have already referred to the increased importance of tomato bug following the introduction of the variety "Bounty." We have shown that tomato bug is controllable by means of pyrethrum, rotenone, and nicotine especially when applied in dust form and also by "Lethane." Because of the present world shortage of pyrethrum and rotenone we are concentrating on such nicotine dusts as will be compatible with cryolite. To date we have secured very satisfactory results with a nicotine-talc dust but our work is still in progress.

Lima bean

A satisfactory control for bean-pod borer, *Maruca testulalis,* has been found in cryolite. Combination treatments of cryolite plus

nicotine or cryolite plus sulphur or all three materials will take care of most insect problems encountered on lima beans.

Cabbage

In normal times most of our head cabbage and Chinese cabbage came from the islands of Maui and Hawaii where cabbage is grown at elevations of 2,000 feet to 4,000 feet. At these elevations cabbage webworm is not a problem; it is an insect of the low elevations.

With a cessation of inter-island shipments of vegetables following the attack on Pearl Harbor and the attempt to grow cabbage on Oahu, where arable lands are all below 1,000 feet, cabbage webworm has been a serious problem. It attacks the growing point and may ruin the plant completely. It attacks, in addition to head cabbage, broccoli, Chinese cabbage, spoon cabbage, mustards, turnip, daikon, radish, and various Oriental crucifers.

We have found that either rotenone or cryolite will control this insect. In general dusts are superior to sprays. As a result of these findings these crops can now be grown under an increasingly wide range of conditions under which it was formerly difficult to grow them.

The cabbage butterfly, a second important insect of cabbage, broccoli, and related plants, has been controlled by means of rotenone and also by arsenate of lead. Arsenate of lead has the greater powers of retention and, in commercial production, can be used in the early stages of growth so as to conserve rotenone. In the later stages of growth, rotenone only should be used. This is a safe nonpoisonous insecticide which can be used by home gardeners on cabbage and broccoli throughout the growth of these crops.

Sweetpotato

We have determined two satisfactory controls for sweetpotato leaf miner—a spray of diesel oil emulsion plus nicotine sulphate and a Paris green spray. (Diesel oil emulsion is the oil emulsion developed by Dr. Carter of the Pineapple Research Institute for control of pineapple mealy bug.)

Green beans

We have worked out satisfactory controls for bean leafhopper, *Empoasca solana* De Long and bean capsid, *Pycnoderes quadrimaculatus,* pyrethrum plus sulphur dust, or sulphur dust alone for the leafhopper, nicotine or rotenone for the capsid. The quantitative records for a single experiment on the control of bean leafhopper involved over 121,000 leafhoppers.

The Chinese rose beetle which consumes the leaves has been in Hawaii for nearly half a century. Because the problem is complex and has many angles to it, time will not permit me to discuss it in detail. Suffice it to say that we are making good progress with it. We have shown that of materials studied to date, arsenate of lead is the only material that has any marked control on it. We are working on the correction of spray burn from arsenate of lead. Meanwhile we are continuing the search for additional materials, that will control the beetle, that do not have the weaknesses of arsenate of lead.

Beet and Chard

For beet and chard we have developed a satisfactory combination treatment which will give almost 100 per cent control of the two major insects—beet webworm and broad mite, and in addition bean leafhopper should it be present.

Corn

The mineral oil method of controlling corn earworm in sweet corn has been studied. It has been found that under Hawaiian conditions a modification of the method used in the mainland United States is necessary, for addition of insecticides to the oil causes a considerable amount of silk rotting.

Pepper

As a result of our finding that a combination treatment of cryolite and sulphur for pepper weevil and broad mite will control these two devastating pests of pepper, pepper production in the Territory is increasing markedly.

All these developments are causing vegetable production to be placed on a more satisfactory basis. Not all the insect problems, however, are solved yet. Improvements in the control measures already developed can undoubtedly be made. But one can say, even now, that satisfactory measures of control have been developed for so many of our vegetable insects, that insect depredations can no longer be said to contribute a limiting factor to vegetable production.

The extent to which insect control has progressed in the past few years can be gauged in some measure by the insecticide sales. In 1938 when we tried to secure cryolite for our experimental work it was necessary for us to order it direct from the manufacturer. Our first rotenone was secured from Dr. Carter who had obtained a small quantity of timbo from Dr. Schmidt who purchased it in Brazil. Rotenone has proved to be the best, all round safe insecticide, for home gardeners who know little of the principles of insec-

ticidal control or of the precautions necessary in using insecticides likely to be poisonous to human beings. A combination dust of rotenone and sulphur is even better and is the best, safe all round insecticide mixture for use in home gardens in Hawaii. But supplies of rotenone are limited and the world shortage is already telling on local supplies.

The success which has attended our investigations demonstrating the value of cryolite for so many insect problems is reflected in the imports of cryolite to Hawaii over the past few years.

The importation of cryolite into Hawaii rose from nil in 1939 to 3,615 pounds in 1940 and to an average of 30,395 pounds per annum in 1941 and 1942. The sales in 1943 will be more than double the sales of last year.[1] County agents and farmers alike speak in glowing terms of the value of cryolite. Often have I had the remark made to me that cryolite is the most valuable single insecticide available at the present time in Hawaii for use in commercial vegetable production.

Conclusion

I have traced the developments in the control of vegetable insects from the beginnings of applied entomology in Hawaii at the opening of the present century. I have traced them through the changing agriculture of the period, and the change of entomologists responsible for vegetable insect work through the period of lessened interest in the insects of vegetable crops to the present period of interest in vegetables for survival. I have touched on the changing scene as regards the insects present, the new insect immigrants and the new problems developed with changed conditions. I have mentioned briefly the control measures developed for many of our important insects. As time goes on, we shall undoubtedly bring more of the insects under control. The picture at present is bright. Nevertheless there is one aspect of the picture that needs watching. We are in very truth at the cross roads of the Pacific. We already possess economic insects from all parts of the earth. Commerce is increasing. Air transport has increased enormously. Since the Territory established its plant inspection and quarantine service in 1903 forty-three new vegetable insects have been recorded in Hawaii and thirteen of them have been recorded since 1938. If 43 species can become established in spite of a plant inspection and quarantine service it is not too much to say that increased vigilance will be needed in the years to come when normal trade is resumed and commercial air services continue to expand.

If, as I have suggested earlier, the increase in occurrence of new immigrant species of economic insects over the past ten or fifteen years is attributable to an increase in importations of vegetables

[1] Sales of cryolite for 1943 amounted to 45 tons.

over that period, might not one answer to the problem be to produce more vegetables locally and thus reduce importations?

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Notes on Insects and Other Arthropods from the Islands of Molokai and Maui, Hawaii

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(Presented at the meeting of December 13, 1943)

The insects and other arthropods listed in this paper were collected on Molokai during the periods May 29 to June 5 and October 8 to 13, and on Maui June 5 to 13, 1943. The Thysanoptera have been reported on in another paper.[1] My thanks are extended to the following persons who have kindly identified most of the specimens: D. T. Fullaway (parasitic Hymenoptera), O. H. Swezey (Coleoptera, some of the Diptera, Cicadellidae, Delphacidae, Cixiidae), F. X. Williams (Hymenoptera, most of the Diptera), E. C. Zimmerman (weevils, Hemiptera), E. O. Essig (Aphididae), H. Morrison (Coccidae), L. M. Russell (Aleyrodidae), R. V. Chamberlin (Araneida) and H. E. Ewing and E. A. McGregor (Acarina). Species apparently here recorded for the first time from Molokai or Maui are marked with an asterisk.

Araneida

**Latrodectus geometricus* Koch, south central Molokai, May 31.

**Latrodectus mactans hesperus* Chamberlin and Ivie, south central Molokai, May 31.

Acarina

Anystis sp., probably *A. agilis* Bks., near edge of Waikolu Valley, Molokai, June 3, ex *Metrosideros* sp.; Wailuku, Maui, June 13, ex leaves of hibiscus.

Tetranychus sp., south central Molokai, May 31, ex leaves *Datura stramonium* L.

Tetranychus sp., nearest *bimaculatus* Harv., Kawela, Molokai, June 2, ex tomato leaves.

Orthoptera

Tettigoniidae

Elimaea punctifera (Walk.), 1, eastern Molokai, May 30.

[1] See p. 113.

Gryllidae

Paratrigonidium atroferrugineum Brunn., 3, near edge of Waikolu Valley, Molokai, Oct. 10.

Locustidae

Atractomorpha ambigua Bol., 1, eastern Molokai, May 30.

Oxya chinensis (Thunb.), 1, Haiku, Maui, June 7.

Mantidae

Tenodera angustipennis Sauss., 1 egg mass with parasite exit holes, probably of *Podagrion mantis* Ashmead, Kaunakakai, *Molokai, June 2; 1 nymph, Kaunakakai, June 4; 1 nymph, Wailuku, Maui, June 6; 1 nymph, Haiku, Maui, June 7.

Blattidae

**Diploptera dytiscoides* (Serv.), 1, Kaunakakai, Molokai, May 29.

**Graptoblatta notulata* (Stål), 1, Iao Valley, Maui, June 6; 1, Hana, Maui, June 9.

**Supella supellectilium* (Serv.), 1 Kaunakakai, Molokai, June 1, in house.

HEMIPTERA

Miridae

**Buchaniella sodalis* (White), 1, Iao Valley, Maui, June 6.

Cyrtopeltis varians (Dist.), 5, Kaunakakai, Molokai, Oct. 8, ex *Gynandropsis pentaphylla* De C.; 10, Kaunakakai, Oct. 13; 3, south central Molokai, May 31; 1, Kawela, Molokai, June 2; 2, Haiku, Maui, June 7.

Hyalopeplus pellucidus (Stål), 1, Halawa Valley, Molokai, May 30; 1, south central Molokai, May 31; near edge of Waikolu Valley, Molokai, June 3 (1) and Oct. 10 (1); 1, Iao Valley, Maui, June 6; 3, Haiku, Maui, June 7.

**Leucopoecila albofasciata* Reut., 1, near edge of Waikolu Valley, Molokai, June 3.

**Physopleurella mundula* (White), 1, Iao Valley, Maui, June 6.

**Pycnoderes quadrimaculatus* Guer., 2, Kamalo, Molokai, Oct. 11, ex bush bean leaves; 1, Ualapue, Molokai, Oct. 11; 5, Haiku, Maui, June 7; 7, Hana, Maui, June 9; 4, Nahiku, Maui, June 10.

Sarona adonias Kirk., 1, near edge of Waikolu Valley, Molokai, Oct. 10.

Anthocoridae

Triphleps persequens White, Kaunakakai, Molokai, May 29 (2), June 4 (3), and 5 (1).

Reduviidae

Empicoris rubromaculatus Blackb., 1, south central Molokai, May 31; 4, Iao Valley, Maui, June 6.

Zelus renardii Kol., Kaunakakai, Molokai, May 29 (2) and June 4 (1); 1, south central Molokai, May 31; 1, Wailuku, Maui, June 6.

Tingidae

Teleonemia scrupulosa Stål, 2, eastern Molokai, May 30; 1, Kaunakakai, Molokai, June 4; 2, Halawa Valley, Molokai, June 4; 6, Wailuku, Maui, June 6; 2, Kaupo, Maui, June 9.

Lygaeidae

Corizus hyalinus (Fabr.), 1, Wailuku, Maui, June 6.

**Geocoris punctipes* (Say), Kaunakakai, Molokai, May 29 (4) and June 4 (2).

**Orthoea vincta* (Say), 2, south central Molokai, May 31; 8, near edge of Waikolu Valley, Molokai, June 3.

Pentatomidae

Oechalia pacifica (Stål), 1, near edge of Waikolu Valley, Molokai, June 3.

Cydnidae

Geotomus pygmaeus (Dallas), 1, eastern Molokai, May 30; 1, Kaunakakai, Molokai, June 4.

HOMOPTERA

Membracidae

**Stictocephala festina* (Say), 2, eastern Molokai, May 30; 8, Kawela, Molokai, June 2; 1, Kaunakakai, Molokai, Oct. 8; 1, Hana, Maui, June 8.

Cicadellidae

**Bythoscopus robustus* (Uhler), 3, Kaunakakai, Molokai, June 4.

**Empoasca solana* De L., Kaunakakai, Molokai, June 4 (2), June 5 (2); 5, Wailuku, Maui, June 13, ex leaves of castor bean.

**Nesophrosyne perkinsi* (Kirk.), Hana, Maui, June 8 (4) and 10 (13).

**Opsius stactogalus* (Amyot), 23, Kaunakakai, Molokai, Oct. 10, ex *Tamarix* sp.

Flatidae

Siphanta acuta (Walk.), near edge of Waikolu Valley, Molokai, June 3 (3) and Oct. 10 (1); 1, Iao Valley, Maui, June 6; 1, Hana, Maui, June 9.

Delphacidae

Aloha ipomoeae Kirk., 2, Halawa Valley, Molokai, June 4; Hana, Maui, June 8 (2) and 10 (2).

**Leialoha lehuae mauiensis* Muir, 3, near edge of Waikolu Valley, Molokai, June 3.

**Leialoha ohiae* (Kirk.), 1, near edge of Waikolu Valley, Molokai, June 3, ex *Metrosideros* sp.; 1, same area, Oct. 10.

Peregrinus maidis (Ashm.), 19, Hoolehua, Molokai, June 1, ex corn plants; 3, Kaunakakai, Molokai, June 4; 12, Iao Valley, Maui, June 6; 12, Haiku, Maui, June 7; 1, Kaupo, Maui, June 9.

Perkinsiella saccharicida Kirk., 1, Hana, Maui, June 8.

Cixiidae

Oliarus haleakalae Kirk. ?, 1, near edge of Waikolu Valley, Molokai, June 3.

Oliarus kahavalu Kirk., 2, Iao Valley, Maui, June 6.

Oliarus similis var. *a* Giffard, near edge of Waikolu Valley, Molokai, June 3 (2), Oct. 10 (1).

Aphididae

Amphorophora sonchi (Oestl.), Hoolehua, Molokai, June 1; Wailuku, Maui, June 6; Hana, Maui, June 8; all ex *Sonchus oleraceus* L.

**Aphis gossypii* Glov., Hoolehua, Molokai, June 1, ex watermelon; Kawela, Molokai, June 2, ex *Crotalaria saltiana* Andr.; Wailuku, Maui, June 13, ex *Lagerstroemia indica* L.; Haiku, Maui, June 7, ex cucumber leaves, upland taro (*Colocasia esculenta* Schott) leaves and hibiscus flowers.

**Aphis maidis* Fitch, Hoolehua, Molokai, June 1, ex corn.

Aphis medicaginis Koch, Moomomi, Molokai, June 1, ex *Tribulus cistoides* L. leaves; Hana, Maui, June 8, ex *Vigna marina* (Burm.) Merr.

**Aphis middletonii* Thomas, Hoolehua, Molokai, June 1, ex *Sonchus oleraceus* L.

**Aphis tavaresi* Del Guer., Wailuku, Maui, June 6.

**Macrosiphum rosae* (Linn.), Keanae, Maui, June 8, ex rose.

**Macrosiphum solanifolii* (Ashm.), Olinda, Maui, June 12, ex *Hypochaeris radicata* L.

Myzus convolvuli (Kalt.), Wailuku, Maui, June 13, ex *Phalaenopsis* sp.

**Neophyllaphis araucariae* Takah., near edge of Waikolu Valley, Molokai, June 3; Hana, Maui, June 10; all from leaves *Araucaria excelsa* R. Br.

**Toxoptera aurantii* (Boyer), near edge of Waikolu Valley, Molokai, June 3, ex *Vaccinium* sp.; Wailuku, Maui, June 13, ex *Lagerstroemia indica* L.

Aleyrodidae

**Bemisia giffardi* (Kot.), Kaunakakai, Molokai, June 4, ex leaves *Citrus* sp.; Iao Valley, Maui, June 6, ex leaves *Citrus* sp.

**Dialeurodes kirkaldyi* (Kot.), Hana, Maui, June 9, ex leaves *Morinda citrifolia* L.

**Pealius hibisci* (Kot.), Wailuku, Maui, June 13, ex leaves *Hibiscus* sp.

Trialeurodes vaporariorum (Westw.), Hoolehua, Molokai, June 1, ex *Sonchus oleraceus* L.; Kawela, Molokai, June 2, ex tomato leaves; Wailuku, Maui, June 6, ex *Sonchus oleraceus* L.

Coccidae

**Aspidiotus lataniae* Sign., Kalae, Molokai, June 1, ex conifer; Iao Valley, Maui, June 6, ex stems *Psidium guajava* L.

**Chrysomphalus aonidum* (L.), Kaunakakai, Molokai, May 29, ex leaves *Eugenia jambolana* Lam.; Wailuku, Maui, June 13, ex leaves *Strelitzia reginae* Banks.

**Coccus viridis* (Green), Iao Valley, Maui, June 6, ex leaves *Psidium guajava* L.; Wailuku, Maui, June 13, ex *Ixora macrothyrsa* (Teij. & Binn.)

**Diaspis boisduvalii* Sign., Wailuku, Maui, June 13, ex *Cattleya* sp.

Phenacaspis sp., presumably *sandwicensis* Fullaway, Wailuku, Maui, June 13, ex leaves *Nerium* sp.

Pseudococcus nipae (Mask.), (as currently recognized), Haiku, Maui, June 7, ex *Psidium guajava* L.

Pseudococcus sp. (*citri* group, probably *kraunhiae* [Kuw.]), Hana, Maui, June 11, ex flower *Alpinia purpurata* (Veill.).

Pseudococcus sp., Kaunakakai, Molokai, May 29, ex *Prosopis chilensis* (Molina) Stuntz. Dr. Morrison writes that neither this nor the following species is included in Miss Amy Suehiro's manuscript revision of the Hawaiian *Pseudococcus*.

Pseudococcus sp., Halawa Valley, Molokai, May 30, ex *Agave rigida* Mill.

Pseudococcus (*Ferrisia*) *virgatus* (Ckll.), Moomomi, Molokai, June 1, ex *Sida fallax* Walp.

Pulvinaria psidii Mask., Halawa Valley, Molokai, May 30, ex *Morinda citrifolia* L. stem.

COLEOPTERA

Carabidae

**Bembidion niloticum batesi* Putz., 4, Kaunakakai, Molokai. May 29, on mud flats near shore.

**Tachys oahuensis* Blackb., 5, Kaunakakai Molokai, May 29, on mud flats near shore.

Coccinellidae

Azya luteipes Muls., Kaunakakai, Molokai, June 4 (1) and 5 (1); Wailuku, Maui, June 6 (2) and 13 (2); 5, Iao Valley, Maui June 6.

Coccinella abdominalis Muls., 1, Ualapue, Molokai, Oct. 11.

Coelophora inaequalis (Fabr.), 1, Kaunakakai, Molokai, May 29; 1, south central Molokai, May 31; 1, Halawa Valley, Molokai, June 4; 1, Iao Valley, Maui, June 6; 1, Haiku, Maui, June 7.

Cryptolaemus montrouzieri Muls., Halawa Valley, Molokai, May 30 (1), and June 4 (1); 1, Kaunakakai, Molokai, June 4; 1, Iao Valley, Maui, June 6; Hana, Maui, June 9 (1) and 10 (1); 1, Nahiku, Maui, June 10.

**Curinus coeruleus* (Muls.), 4, Iao Valley, Maui, June 6; 1, Wailuku, Maui, June 6.

**Hyperaspis jocosa* (Muls.), 4, Iao Valley, Maui, June 6; 1, Wailuku, Maui, June 6; 1, Hana, Maui, June 8.

**Nephus pictus* (Gorh.), 2, south central Molokai, May 31; 1, Wailuku, Maui, June 6.

Platyomus lividigaster Muls., 1, eastern Molokai, May 30; 1, south central Molokai, May 31; 1, Hoolehua, Molokai, June 1; 1, Kawela, Molokai, June 2; 4, Kaunakakai, Molokai, Oct. 9.

Rodolia cardinalis (Muls.), 1, Iao Valley, Maui, June 6.

Scymnus notescens (Blackb.), 1, south central Molokai, May 31; 1, Hoolehua. Molokai, June 1, on watermelon plant; 3, Haiku, Maui, June 7.

Scymnus vagans (Blackb.), 1, Iao Valley, Maui, June 6; Hana, Maui, June 8 (1) and 9 (2); 1, Wailuku, Maui, June 13.

Scymnus vividus Sharp, Kaunakakai, Molokai, May 29 (1), June 4 (1), 5 (2) and 8 (1); 4, south central Molokai, May 31; 2, Kawela, Molokai, June 2.

**Sticholotis punctatus* Crotch, 4, Iao Valley, Maui, June 6.

Mycetophagidae

**Litargus vestitus* Sharp, 1, Hana, Maui, June 9.

Cucujidae

Cryptamorpha desjardinsi (Guer.), 1, Kaunakakai, Molokai, June 1, in house; 1, near edge of Waikolu Valley, Molokai, June 3; 1, Halawa Valley, Molokai, Oct. 12.

Nitidulidae

Carpophilus dimidiatus (Fabr.), 1, Kawela, Molokai, June 2; 2, Haiku, Maui, June 7.

Carpophilus hemipterus (L.), 1, south central Molokai, May 31; 4, Hoolehua, Molokai, June 1; 3, Haiku, Maui, June 7.

Carpophilus humeralis (Fabr.), 3, Kaunakakai, Molokai, May 29; 3, south central Molokai, May 31; 1, Hoolehua, Molokai, June 1; 2, near edge of Waikolu Valley, Molokai, Oct. 10; 4, Haiku, Maui, June 7.

Lathridiidae

**Coluocera maderae* Woll., 18, south central Molokai, May 31, in nests of *Paratrechina longicornis* (Latr.) (crazy ant).

Coninomus nodifer (Westw.), 1, Olinda, Maui, June 12, on *Rubus* sp.

Elateridae

Conoderus exsul (Sharp), 1, Wailuku, Maui, June 6; 2, Kaupo, Maui, June 9.

Bostrichidae

Amphicerus cornutus (Pallas), 1, south central Molokai, May 31.

Sinoxylon conigerum Gerst., 5, south central Molokai, May 31.

Scarabaeidae

Adoretus sinicus Burm., 1, south central Molokai, May 31; 1, Kaunakakai, Molokai, June 4; 1, Hana, Maui, June 11.

Aphodius lividus (Oliv.), 2, Kaunakakai, Molokai, June 3.

**Ataenius cognatus* Lec., 5, Kaunakakai, Molokai, May 29.

Saprosites pygmaeus Harold, 13, Iao Valley, Maui, June 6.

Cerambycidae

Ceresium unicolor (Fabr.), 1, Kahakuloa, Maui, June 12.

Sybra alternans Wied., 3, Moomomi, Molokai, June 1; 1, Halawa Valley, Molokai, Oct. 12; 1, Nahiku, Maui, June 10.

Chrysomelidae

Diachus auratus (Fabr.), 1, Halawa Valley, *Molokai, May 30; 3, Kaunakakai, Molokai, June 4; 1, Wailuku, Maui, June 6.

**Epitrix parvula* (Fabr.), 1, Haiku, Maui, June 7.

Lema trilineata californica Schaeff., 1, south central Molokai, May 31, ex *Datura stramonium* L.; 2, Wailuku, Maui, June 6, ex *Brugmansia arborea* (L.).

Bruchidae

Bruchus amicus Horn, 4, Kawela, Molokai, June 2; Kaunakakai, Molokai, June 4 (3) and Oct. 9 (3); 1, Iao Valley, Maui, June 6.

**Bruchus chinensis* (L.), 1, Kaunakakai, Molokai, June 5; 3, Haiku, Maui, June 7.

Bruchus limbatus Horn, 1, Wailuku, Maui, June 6.
Bruchus prosopis Lec., 1, south central Molokai, May 31.
**Bruchus pruininus* Horn, 1, Kaunakakai, Molokai, Oct. 9.
Bruchus sallaei Sharp, 1, Kaunakakai, Molokai, May 29; 8, Kawela Molokai, June 2, ex pods *Acacia farnesiana* (L.).
Megacerus alternatus Brid., 1, Hoolehua, Molokai, June 1; 4, Halawa Valley, Molokai, Oct. 12.

Tenebrionidae

**Ammophorus insularis* Boh., 2, Kaunakakai, Molokai, May 29.
Blapstinus dilatatus Lec.?, 7, Kaunakakai, Molokai, May 29; 1, south central Molokai, May 31.
Epitragus diremptus Karsch, 2, south central Molokai, May 31; 1, Hoolehua, Molokai, Oct. 9.
Gonocephalum seriatum (Boisd.), 2, Moomomi, Molokai. June 1.
Platydema subfascia (Walk.), 9, Halawa Valley, Molokai, May 30.

Anthribidae

Araecerus fasciculatus (De G.), 1, south central Molokai, May 31; Kaunakakai, Molokai, June 5 (2) and Oct. 9 (1); 1, Wailuku, Maui, June 6; 5, Iao Valley, Maui, June 6.
Araecerus vieillardi (Montr.), 1, Kaunakakai, *Molokai, Oct. 9; 1, Haiku, Maui, June 7; 1, Hana, Maui, June 8.

Curculionidae

Anthonomus eugenii Cano, 2, Kaunakakai, Molokai, May 29; 1, south central Molokai, May 31; 1, Iao Valley, Maui, June 6; 2, Haiku, Maui, June 7.
Athesapeuta cyperi Marshall, 1, Wailuku, Maui, June 6.
Euscepes postfasciatus (Fairm.), 1, Hana, Maui, June 8.
Oxydema fusiforme Woll., 6, Halawa Valley, Molokai, May 30; 36, Iao Valley, Maui, June 6.
Pantomorus godmani (Crotch), 2, near edge of Waikolu Valley, Molokai, June 3; 1, Halawa Valley, Molokai, June 4; 1, Wailuku, Maui, June 6; 2, Haiku, Maui, June 7.
**Pentarthrum obscurum* Sharp, 10, Iao Valley, Maui, June 6.
Stenotrupis prolixa (Sharp), near edge of Waikolu Valley, Molokai, June 3 (1), and Oct. 10, ex dead frond stems *Cibotium* sp. (9).

Scolytidae

**Ericryphalus sylvicola* (Perk.), 1, Iao Valley, Maui, June 6.
Hypothenemus insularis Perk., 1, Iao Valley, Maui, June 6; 1, Haiku, Maui, June 7.
**Xyleborus kraatzi* Eich., 1, Hana, Maui, June 8.

LEPIDOPTERA

Pyralididae

Hymenia fascialis (Cram.), 1, Halawa Valley, Molokai, June 4.

Lycaenidae

Cosmolyce boetica (L.), 1, Halawa Valley, Molokai, June 4; 1, Haiku, Maui, June 7.

DIPTERA

Ceratopogonidae

**Forcypomyia ingrami* Carter, 4, near edge of Waikolu Valley, Molokai, Oct. 10.

Culicidae

Culex quinquefasciatus Say, 1, Olinda, Maui, June 12.

Sciaridae

Neosciara sp., 3, south central Molokai, May 31; 1, Hana, Maui, June 8; 2, Olinda, Maui, June 12.

Pipunculidae

Pipunculus sp., 1, near edge of Waikolu Valley, Molokai, Oct. 10.

Syrphidae

Allograpta obliqua (Say), 2, near edge of Waikolu Valley, Molokai, June 3.

Eumerus marginatus Grims., 1, Halawa Valley, Molokai, June 4.

**Ischiodon scutellaris* (Fabr.), 1, Kahakuloa, Maui, June 12.

Lathyrophthalmus aeneus (Scop.), 2, Kaunakakai, Molokai, May 29.

**Toxomerus marginatus* (Say), 4, near edge of Waikolu Valley, Molokai, June 3; 1, Haiku, Maui, June 7.

Volucella obesa (Fabr.), 1, south central Molokai, May 31.

Tachinidae

Archytas cirphis Curr., 1, near edge of Waikolu Valley, Molokai, June 3; 1, Nahiku, Maui, June 10.

**Chaetogaedia monticola* (Big.), 3, near edge of Waikolu Valley, Molokai, June 3.

**Eucelatoria armigera* (Coq.), 1, Olinda, Maui, June 12.

**Leucostoma atra* Towns., 2, near edge of Waikolu Valley, Molokai, June 3.

Sarcophagidae

**Helicobia helicis* (Towns.), 2, Kawela, Molokai, June 2.

Calliphoridae

**Chrysomyia rufifascies* (Macq.), 1, Nahiku, Maui, June 10.

Anthomyiidae

Lispa metatarsalis Thom., 1, near edge of Waikolu Valley, Molokai, June 3.
Lispocephala sp., 1, near edge of Waikolu Valley, Molokai, June 3.
Lispocephala sp., 1, near edge of Waikolu Valley, Molokai, Oct. 10.
**Ophyra chalcogaster* Wied., 1, Hana, Maui, June 9.

Borboridae

Leptocera ferruginata Stenh.?, 5, Kaunakakai, Molokai, May 29.
Leptocera sp., 4, Olinda, Maui, June 12.

Sciomyzidae

Sciomyza hawaiiensis Grims., 1, Halawa Valley, *Molokai, June 4; 1, Wailuku, Maui, June 6; 1, Iao Valley, Maui, June 6.

Ortalidae

Scholastes bimaculatus Hend., 1, Kaunakakai, Molokai, June 5.

Trypetidae

Ceratitis capitata (Wied.), 1, Iao Valley, Maui, June 6.
Dacus cucurbitae Coq., 3, south central Molokai, May 31; 1, Iao Valley, Maui, June 6; 1, Kaupo, Maui, June 9; 1, Wailuku, Maui, June 13.
Eutreta xanthochaeta Aldr., 1, Halawa Valley, Molokai, June 4; 1, Nahiku, Maui, June 10.

Ephydridae

Brachydeutera hebes Cress., 5, Kawela, Molokai, June 2.
**Notophila insularis* Grims., 7, south central Molokai, May 31.
Procanace nigroviridis Cress., 2, Halawa Valley, Molokai, May 30.
**Scatella bryani* Cress., 3, Kawela, Molokai, June 2.
**Scatella hawaiiensis* Grims., 1, Olinda, Maui, June 12.
Scatella warreni Cress., 10, Halawa Valley, *Molokai, May 30; 1, Kahakuloa, Maui, June 12.

Drosophilidae

**Drosophila spinofemora* P. & W., 1, Halawa Valley, Molokai, June 4; 1, Haiku, Maui, June 7; 3, Hana, Maui, June 9.

Agromyzidae

Liriomyza pusilla (Meig.), 2, near edge of Waikolu Valley, Molokai, Oct. 10.

Ophiomyia lantanae (Frogg.), 1, Halawa Valley, Molokai, June 4.

Milichiidae

Milichiella lacteipennis (Loew), 1, south central Molokai, May 31.

Chloropidae

**Rhodesiella tarsalis* Adams, Hana, Maui, June 8 (1), June 9 (1).

HYMENOPTERA

Braconidae

**Apanteles dignus* Mues., 1, Kawela, Molokai, June 2, reared from lepidopterous larva in tomato leaf.

Apanteles sp. (parasite of *Opogona*), 1, Halawa Valley, Molokai, June 4; 1, near edge of Waikolu Valley, Molokai, Oct. 10; 1, Hana, Maui, June 9.

**Chelonus blackburni* Cam., 1, Kaupo, Maui, June 9.

**Ischiogonus pallidiceps* Perk., 1, south central Molokai, May 31; 2, Iao Valley, Maui, June 6.

**Opius lantanae* Bridw., 1, Kaupo, Maui, June 9.

Ichneumonidae

Amblyteles sp., 1, near edge of Waikolu Valley, Molokai, June 3.

Casinaria infesta (Cress.), 1, Kaunakakai, Molokai, June 4.

Cremastus flavo-orbitalis (Cam.), 1, near edge of Waikolu Valley, Molokai, June 3; 1, Kaupo, Maui, June 9.

Idechthis sp., 2, eastern Molokai, May 30; 1, south central Molokai, May 31; 1, Wailuku, Maui, June 6; 1, Hana, Maui, June 9; 1, Kahakuloa, Maui, June 12.

Pristomerus hawaiiensis Perk., 1, near edge of Waikolu Valley, Molokai, Oct. 10; 1, Hana, Maui, June 9; 1, Kaupo, Maui, June 9.

Scelionidae

Anteris nigricornis Ashm., 1, near edge of Waikolu Valley, Molokai, Oct. 10.

Chalcididae

Brachymeria obscurata (Walk.), 1, Kaunakakai, Molokai, June 4; 1, Kainalu, Molokai, Oct. 12; Hana, Maui, June 8 (1) and 10 (1).

Dirhinus giffardii Silv., 1, Kaunakakai, Molokai, June 4.

**Podagrion mantis* Ashmead, 1, south central Molokai, May 31. This may be the first authentic record of this mantid parasite in the Hawaiian Islands.

Stomatocerus pertorvum Gir., 1, Hana, Maui, June 8; 1, Kaupo, Maui, June 9; 1, Kahakuloa, Maui, June 12.

Eurytomidae

Eurytoma sp., 1, Haiku, Maui, June 7.

Eupelmidae

**Cerambycobius cushmani* Crawf., 1, Wailuku, Maui, June 6.

Eupelmus sp., 1, Iao Valley, Maui, June 6.

Encyrtidae

**Aenasius advena* Comp., 3, Moomomi, Molokai, June 1; Kaunakakai, Molokai, June 5 (1) and Oct. 9 (1); 1, Hana, Maui, June 10.

Encyrtus infelix (Embl.), 1, near edge of Waikolu Valley, Molokai, June 3.

Eulophidae

Astichus sp., 1, near edge of Waikolu Valley, Molokai, June 3.

Euderus metallicus (Ashm.), 7, near edge of Waikolu Valley, Molokai, June 3; 4, Olinda, Maui, June 12.

Pseudopheliminus vagans Timb., 1, Iao Valley, Maui, June 6; 1, Hana, Maui, June 10.

Tetrastichus giffardianus Silv., 1, Kaunakakai, Molokai, June 5.

Tetrastichus sp., 1, Iao Valley, Maui, June 6.

Formicidae

Camponotus (*Tanaemyrmex*) *variegatus hawaiiensis* For., 3, Kaunakakai, Molokai, May 29.

Cardiocondyla emeryi For., Kaunakakai, Molokai, June 4 (3) and Oct. 8 (1); 1, Halawa Valley, Molokai, June 4; Hana, Maui, June 8 (5) and 9 (1).

Leptogenys falcigera insularis Smith, 4, Iao Valley, Maui, June 6.

**Monomorium minutum liliuokalanii* For., 9, Hoolehua, Molokai, June 1; 1, Hana, Maui, June 9.

**Paratrechina longicornis* (Latr.), 18, south central Molokai, May 31; 9, Kawela, Molokai, June 2.

Paratrechina (*Nylanderia*) *bourbonica hawaiiensis* (For.), 1, Halawa Valley, Molokai, June 4; Hana, Maui, June 8 (6) and 9 (5).

**Paratrechina* (*Nylanderia*) *sharpii* (For.), 1, Hana, Maui, June 9.

Pheidole megacephala (Fabr.), 2, Hana, Maui, June 9.

**Plagiolepis exigua* For., 7, Halawa Valley, Molokai, May 30.

Ponera perkinsi For., 2, Halawa Valley, Molokai, May 30.

Technomyrmex albipes (F. Smith), 5, Halawa Valley, Molokai, May 30.
Tetramorium guineense (Fabr.), 3, eastern Molokai, May 30; 8, Hana, Maui, June 10.

Mimesidae

Nesomimesa nitida Perk., 1, near edge of Waikolu Valley, Molokai, Oct. 10.

Eumenidae

Odynerus homeogaster Perk., 1, Nahiku, Maui, June 10.
Odynerus molokaiensis Perk., 2, near edge of Waikolu Valley, Molokai, Oct. 10.
Odynerus nigripennis (Holm.), 2, Kaupo, Maui, June 9.
Odynerus purpurifera Perk., 1, eastern Molokai, May 30.
Odynerus sandwichensis D. T., 1, Kaupo, Maui, June 9.
Pachodynerus nasidens (Latr.), 1, Kawela, Molokai, June 2; 2, Kaunakakai, Molokai, June 4; 1, Wailuku, Maui, June 6; 1, Kaupo, Maui, June 9.

Vespidae

Polistes fuscatus aurifer (Sauss.), 1, Kaunakakai, Molokai, June 4.
Polistes olivaceus (De G.), 1, Haiku, Maui, June 7.

Dryinidae

Pseudogonatopus perkinsi (Ashm.), 1, near edge of Waikolu Valley, Molokai, June 3, ex *Metrosideros* sp.

Crabronidae

Nesocrabro adspectans (B. & C.), 1, near edge of Waikolu Valley, Molokai, Oct. 10.
Xenocrabro mandibularis (Sm.), 1, near edge of Waikolu Valley, Molokai, Oct. 10.
Xenocrabro molokaiensis (Perk.), 1, near edge of Waikolu Valley, Molokai, June 3.

Trypoxylonidae

Pison hospes Sm., 1, Kaunakakai, Molokai, June 4.
**Pison iridipennis* Sm., 2, south central Molokai, May 31; 1, Kawela, Molokai, June 2.
Trypoxylon bicolor Smith, 1, south central Molokai, May 31; 1, Kawela, Molokai, June 2.

Sphecidae

**Astata bella* Cress., 1, Kaunakakai, Molokai, Oct. 9.

Scoliidae

Campsomeris marginella modesta (Smith), 1, Kaunakakai, Molokai, June 4; 1, Kaupo, Maui, June 9.

Larridae

Notogonidea subtessellata (Smith). 1, Kawela, Molokai, June 2.

Hylaeidae

Nesoprosopis facilis (Sm.), 2, near edge of Waikolu Valley, Molokai, Oct. 10; 1, Hana, Maui, June 10.

Megachilidae

Megachile gentilis Cress., 1, Kawela, Molokai, June 2; 2, Kaunakakai, Molokai, Oct. 13.

Megachile schauinslandi Alfk., Kaunakakai, Molokai, June 4 (1), Oct. 8 (1) and 13 (2).

Apidae

Apis mellifera L., 1, south central Molokai, May 31.

Some First Records of Aphids in Hawaii*

BY WM. C. LOOK AND ETHEL LUCAS McAFEE
Hawaii Agricultural Experiment Station

(Presented at the meeting of March 8, 1943)

Since the reestablishment of an Entomology Department in the Hawaii Agricultural Experiment Station, University of Hawaii, in 1937, numerous observations have been made of the insects of diversified crops. These observations have established the presence in Hawaii of a number of insects not formerly recorded here. The present contribution gives the first records of eight species of aphids.

Amphorophora sonchi (Oestlund)

This species was determined by Professor Essig in June 1940 as *Amphorophora sonchi* (Oestlund). Timberlake (7)† recorded an aphid *A. lactucae* (Kaltenbach) on *Sonchus oleraceus* (common sow thistle) in 1922. This aphid is apparently the same species as *A. sonchi* (Oestlund). *A sonchi* has been observed breeding freely on *S. oleraceus*. Alates have been found on *Solanum tuberosum* (potato) and *Ipomea batatas* (sweetpotato) as well as on *Lycopersicon esculentum*. To date, all of our collections have been made during the cooler months of the year.

Aphis rumicis Linnaeus

This species occurs commonly on various legumes in other parts of the world. In Hawaii it breeds on *Phaseolus limensis* (lima bean), but *A. medicaginis* Koch is the more common and more important species. The determination of both species has been made by Professor Essig.

A. rumicis is an important vector of several virus diseases (5, 6), the most important of which is probably the bean mosaic.

Cavariella capreae (Fabricius)

The yellow willow aphid has a rather wide distribution throughout the temperate regions (2). Except for this first collection at Kohala, Hawaii, this aphid has not been found on carrots in the Territory. Observations to date indicate that *Brevicoryne brassicae* (Linnaeus) is a more important species on carrot than is *C.*

* Published with the approval of the Director as Technical Paper No. 108 of the Hawaii Agricultural Experiment Station.
† Numbers in parentheses refer to the bibliography.

Table 2. Some First Records of Aphids in Hawaii

Species	Date	Host	Locality	Collector	Stage	Identified by
**Amphorophora sonchi* (Oestlund)	Dec. 15, 1939	*Lycopersicon esculentum* (tomato)	Lualualei, Oahu	W. C. Look	Alate	E. O. Essig
Aphis rumicis Linnaeus	Jan. 23, 1938	*Erechtites valerianaefolia*§ (fireweed)	Lower Tantalus, Oahu	E. McAfee	Alate Apterous	E. McAfee
Brachycolus heraclei Takahashi	Dec. 6, 1940	*Apium graveolens dulce* (celery)	Waialua, Oahu	F. G. Holdaway	Alate Apterous	E. O. Essig
†*Cavariella capreae* (Fabricius)	Jan. 25, 1939	*Daucus carota sativa* (carrot)	Kohala, Hawaii	G. Marvin	Alate Apterous	S. H. Au
Macrosiphum rosaefolium Theobald	Nov. 22, 1940	*Rosa* sp. (rose)	Manoa, Oahu	W. C. Look	Alate Apterous	E. O. Essig
‡*Micromyzus formosanus* (Takahashi)	Dec. 20, 1939	*Allium cepa* (onion) *Allium schoenoprasum* (chive)	Kaneohe, Oahu	W. C. Look	Alate Apterous	E. O. Essig
Myzus convolvuli (Kaltenbach)	Feb. 2, 1941	*Euphorbia* sp. *Spathoglottis plicata* (wild ground orchid)	Waikane-Kahana Trail, Oahu	E. McAfee	Apterous Apterous	E. O. Essig E. O. Essig
**Rhopalosiphum pseudobrassicae* (Davis)	Oct. 20, 1939	*Lycopersicon esculentum* (tomato)	Kaneohe, Oahu	W. C. Look	Alate	E. O. Essig

* Previously published (4).
† See Proc. Haw. Ent. Soc., 11(3): 270, 1943.
‡ Previously published (3, 4).
§ Det. by Dr. H. St. John.

capreae. Reference to the specimens on which this record is based has already been made by D. T. Fullaway.[1]

Macrosiphum rosaefolium Theobald

This species was found breeding freely on roses. Aphids collected a year previously on these same rose bushes were *Myzus circumflexus* (Buckton). It appears that *M. rosaefolium* may, therefore, be a comparatively recent introduction into Hawaii.

Micromyzus formosanus (Takahashi)

This species has since been observed attacking onion at several different places on Oahu. An aphid was reported attacking green onion at Makaweli, Kauai in March 1941. It would appear that *M. formosanus* may have established itself on Kauai in recent years.

Myzus convolvuli (Kaltenbach)

This species has a wide range of hosts elsewhere; it has been found on important crops such as *Apium graveolens dulce* (celery), *Lactuca sativa* (lettuce), *Pisum sativum* (pea), *Solanum tuberosum* (potato), and *Lycopersicon esculentum* (tomato). It is an important vector of western celery mosaic (5) and narcissus mosaic (1).

Rhopalosiphum pseudobrassicae (Davis)

The turnip aphid has become established as an important insect of *Brassica oleracea botrytis* (broccoli), *B. pekinensis* (Chinese cabbage), and *Raphanus sativus longipinnatus* (daikon). It is a vector of several strains of viruses, of which bean mosaic and cauliflower mosaic are the most important (5, 6).

ACKNOWLEDGMENT

We wish to thank Dr. F. G. Holdaway for his valuable suggestions and direction in the preparation of this paper. We are indebted to Professor E. O. Essig and S. H. Au for assistance in making the determinations.

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New Host Records of Aphids in Hawaii*

BY WM. C. LOOK AND ETHEL LUCAS McAFEE

Hawaii Agricultural Experiment Station

(Presented at the meeting of April 12, 1943)

In connection with the observations which have been made by the Entomology Department of the Hawaii Agricultural Experiment Station of the insects of diversified crops, many insects have been recorded on plants which were not formerly recorded as hosts in Hawaii.

The present contribution gives new host records of aphids secured during the past few years. It includes host records of eight species only recently recorded as occurring in Hawaii (9).[1]

Amphorophora sonchi (Oestlund)

This species breeds in abundance on *Sonchus oleraceus*. Up to the present, only alates have been found on sweet potato and tomato. Only further observations can determine whether this species is capable of breeding on these plants.

Aphis gossypii Glover

The melon aphid is probably the most common aphid in Hawaii. It has a wide range of hosts. It was found breeding on every host given in table 3. It breeds in great numbers on *Crotalaria mucronata*, sweet potato, and tomato.

This species is the carrier of several destructive viruses. Holmes (8) lists seven different viruses. The more important diseases are the cucumber mosaic, the bean mosaic, cauliflower mosaic, and two celery mosaics. It also transmits the yellow dwarf virus of onion and the celery calico virus (8, 12).

Aphis maidis Fitch

The corn leaf aphid was found breeding on asparagus, papaya, summer squash, and tomato. Only alates were found on pole bean and potato. Further observations may determine whether *A. maidis* is capable of breeding on these other plants also.

This species transmits the viruses of sugar cane mosaic, cucumber mosaic, yellow dwarf of onion, southern celery mosaic and maize mosaic (8).

* Published with the approval of the Director as Technical Paper No. 109 of the Hawaii Agricultural Experiment Station.

[1] Numbers in parentheses refer to the bibliography.

New Host Records of Aphids in Hawaii

Table 3

Key: § Observed—* Previously published (7)—‡ Previously published (6)—† Determined by Dr. H. St. John

Species	Host	Date	Locality	Collector	Stage	Identified by
Amphorophora sonchi (Oestlund)	*Ipomoea batatas* (L.) Poir. (sweetpotato)	Jan. 16, 1941	Poamoho, Oahu	W. C. Look	Alate	E. McAfee
		Jan. 24, 1941	Kipapa, Oahu	W. C. Look	Alate	E. McAfee
	Lycopersicon esculentum Mill. (tomato)	Dec. 15, 1939	Lualualei, Oahu	W. C. Look	Alate	E. O. Essig
		Dec. 15, 1939	Kahuku, Oahu	W. C. Look	Alate	E. O. Essig
		Jan. 1, 1940	Puuloa, Oahu	W. C. Look	Alate	E. O. Essig
	Sonchus oleraceus L. (common sow thistle)	Jan. 26, 1941	Koko Head, Oahu	E. McAfee	Alate, apterous	E. McAfee
		Feb. 6, 1941	Puuloa, Oahu	E. McAfee	Alate, apterous	E. McAfee
Aphis gossypii Glover	*Carica papaya* L. (papaya)	Sept. 15, 1938	Kona, Hawaii	M. Masuda	Apterous	E. McAfee
		Jan. 17, 1940	Lualualei, Oahu	W. C. Look	Apterous	E. O. Essig
		Feb. 8, 1940	Kailua, Oahu	W. C. Look	Alate	E. O. Essig
		Feb. 8, 1940	Koko Head, Oahu	W. C. Look	Alate	E. O. Essig
		Feb. 28, 1940	Pupukea, Oahu	W. C. Look	Alate	E. McAfee
	Cattleya sp. (cultivated orchid)	Feb. 7, 1941	Upper Makiki, Oahu	A. C. Browne	Apterous	E. McAfee
	Crotalaria mucronata Desv. (rattlebox)	Apr. 3, 1939	Poamoho, Oahu	W. C. Look	Alate, apterous	E. McAfee
	Erechtites valerianaefolia DC. (fireweed)	Sept. 21, 1940	Kipapa, Oahu	E. McAfee	Alate, apterous	E. McAfee
	Ipomoea batatas (L.) Poir. (sweetpotato)	Oct. 9, 1940	Waipahu, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Jan. 24, 1941	Kipapa, Oahu	W. C. Look	Alate	E. McAfee
		Jan. 29, 1941	Kaneohe, Oahu	W. C. Look	Alate,	E. McAfee

Species	Host	Date	Locality	Collector	Stage	Identified by
		Jan. 29, 1941	Kaneohe, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Feb. 13, 1941	Kahaluu, Oahu	W. C. Look	Alate, apterous	E. McAfee
Aphis gossypii Glover	*Lycopersicon esculentum* Mill. (tomato)	Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Alate	E. McAfee
		Oct. 20, 1939	Koko Head, Oahu	W. C. Look	Alate	E. O. Essig
		Nov. 22, 1939	Lualualei, Oahu	W. C. Look	Alate	S. H. Au
		Sept. 25, 1940	Waipahu, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Jan. 29, 1941	Kaneohe, Oahu	W. C. Look	Alate, apterous	E. McAfee
	Passiflora edulis Sims (passion fruit)	Feb. 8, 1940	Pensacola, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Apr. 19,1940	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
	‡*Phaseolus vulgaris* L. (pole bean)	Aug. 8, 1939	Waipahu, Oahu	W. C. Look	Apterous	S. H. Au
		Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Alate	S. H. Au
Aphis maidis Fitch	*Asparagus officinalis* L. (asparagus)	Aug. 1, 1939	Waipahu, Oahu	W. C. Look	Alate, apterous	E. McAfee
	**Carica papaya* L. (papaya)	Apr. 7, 1939	Poamoho, Oahu	W. C. Look	Apterous	E. McAfee
	Cucurbita pepo L. (summer squash)	Apr. 3, 1941	Waipahu, Oahu	W. C. Look	Alate	E. McAfee
	**Lycopersicon esculentum* Mill. (tomato)	Sept. 6, 1939	Lualualei, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Oct. 20, 1939	Koko Head, Oahu	W. C. Look	Alate	E. McAfee
		Oct. 27, 1939	Waipahu, Oahu	W. C. Look	Alate	E. McAfee
		Jan. 15, 1940	Puuloa, Oahu	W. C. Look	Alate	E. O. Essig
	‡*Phaseolus vulgaris* L. (pole bean)	Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Alate	E. McAfee

New Host Records of Aphids in Hawaii

Table 3—Continued

Species	Host	Date	Locality	Collector	Stage	Identified by
Aphis maidis Fitch	*Solanum tuberosum* L. (potato)	Dec. 15, 1939	Poamoho, Oahu	W. C. Look	Alate	E. McAfee
Aphis medicaginis Koch	**Asparagus officinalis* L. (asparagus)	Aug. 29, 1939	Waipahu, Oahu	W. C. Look	Alate, apterous	E. McAfee
	Carica papaya L. (papaya)	Feb. 15, 1940	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
		Aug. 23, 1940	Waipahu, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Mar. 7, 1941	Kailua, Oahu	W. C. Look	Alate, apterous	E. McAfee
	Erechtites valerianaefolia DC. (fireweed)	Sept. 21, 1940	Kipapa, Oahu	E. McAfee	Alate, apterous	E. McAfee
	Ipomoea batatas (L.) Poir. (sweetpotato)	Oct. 9, 1940	Waipahu, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Dec. 12, 1940	Lualualei, Oahu	W. C. Look	Apterous	E. McAfee
		Jan. 4, 1941	Kipapa, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Jan. 24, 1941	Wahiawa, Oahu	W. C. Look	Alate, apterous	E. McAfee
	Lycopersicon esculentum Mill. (tomato)	Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Apterous	E. McAfee
		Nov. 22, 1939	Lualualei, Oahu	W. C. Look	Alate	E. O. Essig
		Mar. 13, 1940	Kaaawa, Oahu	W. C. Look	Alate	S. H. Au
	Solanum tuberosum L. (potato)	Sept. 21, 1940	Poamoho, Oahu	W. C. Look	Apterous	E. McAfee
Aphis middletonii Thomas	**Carica papaya* L. (papaya)	Feb. 13, 1940	Kahaluu, Oahu	W. C. Look	Alate, apterous	E. O. Essig
		Feb. 15, 1940	Lualualei, Oahu	W. C. Look	Alate	S. H. Au

Species	Host	Date	Locality	Collector	Stage	Identified by
Aphis middletonii Thomas	**Lycopersicon esculentum* Mill. (tomato)	Dec. 15, 1939	Kahuku, Oahu	W. C. Look	Alate	E. O. Essig
		March 8, 1940	Lualualei, Oahu	W. C. Look	Alate	E. O. Essig
Aphis rumicis Linnaeus	*Erechtites valerianaefolia* DC.† (fireweed)	Jan. 23, 1938	Lower Tantalus, Oahu	E. McAfee	Alate, apterous	E. McAfee
	Nothopanax guilfoylei (C. & M.) Merrill (panax)	March 14, 1941	Kailua, Oahu	L. C. Bishop	Alate, apterous	E. McAfee
	Phaseolus limensis Macf. (lima bean)	Apr. 21, 1939	Waialua, Oahu	W. C. Look	Alate, apterous	E. O. Essig
Aphis sacchari Zehntner	*Ipomoea batatas* (L.) Poir. (sweetpotato)	Feb. 4, 1941	Pearl City, Oahu	W. C. Look	Alate	E. McAfee
		Feb. 6, 1941	Puuloa, Oahu	W. C. Look	Alate	E. McAfee
	Lycopersicon esculentum Mill. (tomato)	Oct. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate	S. H. Au
		Oct. 27, 1939	Waipahu, Oahu	W. C. Look	Alate	E. O. Essig
		Dec. 13, 1939	Lualualei, Oahu	W. C. Look	Alate	E. O. Essig
	‡*Phaseolus vulgaris* L. (pole bean)	Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Alate	E. O. Essig
	Solanum tuberosum L. (potato)	Mar. 29, 1940	Poamoho, Oahu	W. C. Look	Alate	S. H. Au
	Sonchus oleraceus L. (common sow thistle)	Feb. 6, 1941	Puuloa, Oahu	E. McAfee	Alate	E. McAfee
Brachycolus heraclei Takahashi	*Apium graveolens* L. (celery)	Dec. 6, 1940	Waialua, Oahu	F. G. Holdaway	Alate, apterous	E. O. Essig
		May 22, 1941	Lahainaluna, Maui	F. Ako	Alate, apterous	E. McAfee
Cavariella capreae (Fabricius)	*Daucus carota* L. (carrot)	Jan. 25, 1939	Kohala, Hawaii	G. Marvin	Alate, apterous	S. H. Au
Macrosiphum solanifolii (Ashmead)	*Brassica chinensis* L. (white mustard cabbage)	Mar. 27, 1940	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
	Brassica oleracea botrytis L. (broccoli)	March 20, 1940	Waipahu, Oahu	E. McAfee	Alate	E. McAfee

Key: § Observed—* Previously published (7)—‡Previously published (6)—† Determined by Dr. H. St. John.

New Host Records of Aphids in Hawaii

Table 3—Continued

Species	Host	Date	Locality	Collector	Stage	Identified by
Macrosiphum solanifolii (Ashmead)	*Carica papaya* L. (papaya)	March 9, 1939	Poamoho, Oahu	W. C. Look§	Alate, apterous	W. C. Look
		Feb. 15, 1940	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
		Feb. 28, 1940	Pupukea, Oahu	W. C. Look	Alate	E. McAfee
		Mar. 13, 1941	Lualualei, Oahu	W. C. Look§	Alate, apterous	W. C. Look
	Ipomoea batatas (L.) Poir. (sweetpotato)	Feb. 4, 1941	Pearl City, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Feb. 6, 1941	Aiea, Oahu	W. C. Look	Alate	E. McAfee
	Lactuca sativa L. (lettuce)	Feb. 4, 1941	Waipahu, Oahu	W. C. Look	Alate, apterous	E. McAfee
	Lycopersicon esculentum Mill. (tomato)	Apr. 14, 1938	Waipahu, Oahu	F. G. Holdaway	Alate, apterous	S. H. Au
		Dec. 28, 1939	Pupukea, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Jan. 15, 1940	Puuloa, Oahu	W. C. Look	Apterous	E. McAfee
		Feb. 19, 1940	Central Kona, Hawaii	T. Ihara	Alate, apterous	E. McAfee
		Mar. 13, 1940	Kaaawa, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Mar. 5, 1941	Waiawa, Oahu	F. Okumura	Alate, apterous	E. McAfee
	Pisum sativum L. *macrocarpon* Ser. (edible-podded pea)	Mar. 20, 1940	Waipahu, Oahu	E. McAfee	Alate, apterous	E. McAfee
	Solanum melongena L. (eggplant)	July 13, 1939	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
		Apr. 10, 1940	Kailua, Oahu	M. Masuda	Apterous	E. McAfee

Species	Host	Date	Locality	Collector	Stage	Identified by
Macrosiphum solanifolii (Ashmead)	*Solanum tuberosum* L. (potato)	Mar. 30, 1938	Waipahu, Oahu	F. G. Holdaway	Alate, apterous	S. H. Au
		Feb. 6, 1939	Poamoho, Oahu	W. C. Look	Alate, apterous	S. H. Au
	Sonchus oleraceus L. (common sow thistle)	Feb. 6, 1941	Puuloa, Oahu	E. McAfee	Alate	E. McAfee
Macrosiphum rosaefolium Theobald	*Rosa* sp. (rose)	Nov. 22, 1940	Manoa, Oahu	W. C. Look	Alate, apterous	E. O. Essig
Micromyzus formosanus (Takahashi)	‡*Phaseolus vulgaris* L. (pole bean)	Dec. 20, 1939	Kaneohe, Oahu	W. C. Look	Apterous	E. O. Essig
	Allium cepa L. (onion)	Dec. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate, apterous	E. O. Essig
		Mar. 25, 1940	Waipahu, Oahu	W. C. Look	Apterous	E. McAfee
		Mar. 10, 1941	Wahiawa, Oahu	F. Okumura	Apterous	E. McAfee
		Apr. 14, 1941	U. H., Manoa, Oahu	W. C. Look	Apterous	E. McAfee
	Allium schoenoprasum L. (chive)	Dec. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate, apterous	E. O. Essig
Myzus circumflexus (Buckton)	*Carica papaya* L. (papaya)	Jan. 17, 1940	Lualualei, Oahu	W. C. Look	Apterous	E. O. Essig
		Feb. 8, 1940	Kailua, Oahu	W. C. Look	Alate, apterous	E. O. Essig
	Rosa sp. (rose)	Nov. 2, 1939	Manoa, Oahu	W. C. Look	Apterous	E. O. Essig
Myzus convolvuli (Kaltenbach)	*Euphorbia* sp.	Feb. 2, 1941	Waikane-Kahana Trail, Oahu	E. McAfee	Apterous	E. O. Essig
	Spathoglottis plicata Bl. (wild ground orchid)					
Myzus persicae (Sulzer)	*Arctium lappa* L. (gobo—great burdock)	Sept. 9, 1940	Waimea, Hawaii	E. McAfee	Alate, apterous	E. O. Essig
	Beta vulgaris L. (garden beet)	Apr. 16, 1941	Kahala, Oahu	W. C. Look	Apterous	E. McAfee
	Brassica pekinensis Rupr. (Chinese cabbage)	Dec. 7, 1939	Kipapa, Oahu	F. Okumura	Alate, apterous	E. McAfee

Key: § Observed—* Previously published (7)—‡Previously published (6)—† Determined by Dr. H. St. John.

New Host Records of Aphids in Hawaii

Table 3—Continued

Species	Host	Date	Locality	Collector	Stage	Identified by
Myzus persicae (Sulzer)	*Crotalaria mucronata* Desv. (rattlebox)	Apr. 13, 1939	Poamoho, Oahu	W. C. Look	Alate, apterous	E. McAfee
	Ipomoea batatas (L.) Poir. (sweetpotato)	Oct. 9, 1940	Poamoho, Oahu	W. C. Look	Apterous	E. McAfee
		Dec. 20, 1940	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
		Jan. 29, 1941	Koko Head, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Feb. 4, 1941	Pearl City, Oahu	W. C. Look	Alate	E. McAfee
		Feb. 6, 1941	Puuloa, Oahu	W. C. Look	Alate, apterous	E. McAfee
	Lactuca sativa L. (lettuce)	Sept. 9, 1940	Waimea, Hawaii	E. McAfee	Alate, apterous	E. O. Essig
		Feb. 4, 1941	Waipahu, Oahu	W. C. Look	Alate	E. McAfee
	Lycopersicon esculentum Mill. (tomato)	Oct. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate	E. O. Essig
		Oct. 27, 1939	Waipahu, Oahu	W. C. Look	Alate	E. O. Essig
		Dec. 15, 1939	Kahuku, Oahu	W. C. Look	Alate	E. O. Essig
		Mar. 8, 1940	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
		Mar. 13, 1940	Kaaawa, Oahu	W. C. Look	Alate	E. O. Essig
		Mar. 27, 1943	Manoa, Oahu	W. C. Look	Apterous	W. C. Look
	‡*Phaseolus vulgaris* L. (pole bean)	Apr. 18, 1939	Lualualei, Oahu	W. C. Look	Alate, apterous	E. O. Essig
		Aug. 8, 1939	Waipahu, Oahu	W. C. Look	Alate	E. McAfee
		Dec. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate	E. McAfee
	Raphanus sativus L. *longipinnatus* Bailey (daikon)	Sept. 9, 1940	Waimea, Hawaii	E. McAfee	Alate, apterous	E. O. Essig
Pentalonia nigronervosa Coquerel	*Colocasia esculenta* (L.) Schott. (taro)	Sept. 6, 1939	Manoa, Oahu	E. McAfee	Alate	E. McAfee

Species	Host	Date	Locality	Collector	Stage	Identified by
	Lycopersicon esculentum Mill. (tomato)	Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Alate	E. McAfee
Rhopalosiphum nymphaeae (Linnaeus)	‡*Phaseolus vulgaris* L. (pole bean)	Dec. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate	S. H. Au
	Solanum tuberosum L. (potato)	Jan. 16, 1941	Poamoho, Oahu	W. C. Look	Alate	E. McAfee
Rhopalosiphum pseudobrassicae (Davis)	*Brassica oleracea botrytis* L. (broccoli)	Mar. 20, 1940	Waipahu, Oahu	F. G. Holdaway	Alate	E. O. Essig
	Brassica pekinensis Rupr. (Chinese cabbage)	Dec. 7, 1939	Kipapa, Oahu	F. Okumura	Alate, apterous	E. O. Essig
	Raphanus sativus L. *longipinnatus* Bailey (daikon)	Apr. 10, 1940	Lualualei, Oahu	W. C. Look	Alate, apterous	E. O. Essig
	Lycopersicon esculentum Mill. (tomato)	Oct. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate	E. O. Essig
Toxoptera aurantii (Fonscolombe)	*Calophyllum inophyllum* L. (kamani)	Feb. 26, 1941	Manoa, Oahu	E. McAfee	Alate, apterous	E. O. Essig
Vesiculaphis caricis (Fullaway)	*Lycopersicon esculentum* Mill. (tomato)	June 12, 1940	Waipahu, Oahu	W. C. Look	Alate	E. O. Essig

Key: § Observed—* Previously published (7)—‡ Previously published (6)—† Determined by Dr. H. St. John

Aphis medicaginis Koch

The bean aphid generally breeds freely on legumes. On every host recorded in table 3, it was found breeding. It has been observed breeding in abundance on asparagus, firewood, papaya, and sweet-potato.

This species has been found to be one of the vectors of bean mosaic (12).

Aphis middletonii Thomas

This species has been reported elsewhere to be primarily a root feeder and has also been found at the bases of plants (2). In Hawaii, it was observed breeding on young leaves of papaya. Only alates were found on tomato.

It is one of the vectors of cauliflower mosaic and western celery mosaic (8).

Aphis rumicis Linnaeus

This aphid is an important species on beans in the United States. Adults and young have been observed on lima bean only once at Waialua, Oahu. Other host records were on fireweed and *Nothopanax guilfoylei.*

A. rumicis is a vector of bean mosaic, pea mosaic, sugar beet mosaic, western celery mosaic, and yellow dwarf disease of onion (8). It also transmits the virus of white clover mosaic (12).

Aphis sacchari Zehntner

In the records of the sugar cane aphid given in table 3, only alates were found. Only further observations can determine whether this species is capable of breeding on any of these plants.

Brachycolus heraclei Takahashi

This aphid was first recorded from the Orient. Patch (11) lists five species of food-plants of this aphid. They are *Apium graveolens, Coriandrum sativum, Cryptotaenia canadensis, Cryptotaenia japonica,* and *Heracleum* sp.

Cavariella capreae (Fabricius)

This species has been reported from Europe, South America, and the United States (2). It has been shown to be a vector of cauliflower mosaic and western celery mosaic diseases (8).

Macrosiphum rosaefolium Theobald

This aphid was originally described from Egypt. In 1931, it was collected on roses in California (3). Patch (11) also records *Rosa* as a food-plant of this aphid.

Macrosiphum solanifolii (Ashmead)

The potato aphid breeds freely on potato and tomato. It has been found breeding on eggplant, lettuce, Chinese pea, and papaya. Although Timberlake (13) reported an abundance of this aphid on *Sonchus,* only alates have been collected by us from this host.

M. solanifolii is second only to *Myzus persicae* in importance as a vector of plant virus diseases. Holmes (8) mentions eleven different strains of viruses which it transmits. Smith (12) records an additional three, less important viruses. Cucumber mosaic, tobacco mosaic, bean mosaic, and spindle-tuber of potato are the most important diseases. The virus of woodiness disease of passion fruit is also transmitted by the potato aphid (10).

Micromyzus formosanus (Takahashi)

Up to the present, this species has been found breeding in abundance only on onion and chives. The additional record was made on bean plants growing near a bed of chives which were heavily infested with *M. formosanus.* It would appear that these aphids were not breeding on beans.

Myzus circumflexus (Buckton)

The lily aphid has been reported to have a wide range of hosts elsewhere (2). In Hawaii, it has been found breeding freely on papaya and *Rosa.*

M. circumflexus is an important vector of cucumber mosaic, potato leaf-roll, tobacco mosaic, cauliflower mosaic, and western celery mosaic (8). Bawden (1) includes, in addition to these diseases, the mosaic of *Commelina, Hyoscyamus* "3" virus, potato "A" virus, and potato "Y" virus.

Myzus convolvuli (Kaltenbach)

Except for this one record made at the Waikane-Kahana trail, the foxglove aphid has not been collected by us in Hawaii.

M. convolvuli is the vector of two mosaic diseases (8) and is believed to be the vector of *Freesia* mosaic (12). Holmes (8) mentions *Myzus pseudosolani* Theobald as a vector of cucumber mosaic, potato leaf-roll, and tobacco mosaic. Essig (2) considers *M. pseudosolani* Theobald as a synonym of *M. convolvuli* (Kaltenbach).

Myzus persicae (Sulzer)

The green peach aphid is one of the most important species in Hawaii. On all of the hosts recorded in table 3, it was found breed-

ing. It has been observed breeding freely on Chinese cabbage, head cabbage, daikon, eggplant, papaya, pepper and potato.

M. persicae is the most important aphid vector of virus diseases. It is reported by Holmes (8) to be capable of transmitting 19 different strains of plant viruses. Smith (12) mentions five additional strains and Bawden (1) includes the mosaic of *Commelina*. Noble (10) has shown that it is a vector of woodiness diseases of passion fruit. The more important diseases are cucumber mosaic, tobacco mosaic, potato spindle-tuber, potato leaf-roll, bean mosaic, sugar beet mosaic, cauliflower mosaic, and turnip mosaic.

Pentalonia nigronervosa Coquerel

Although the first records of banana aphid on taro are of an alate, other observations indicate that it breeds freely on this host. It also breeds freely on ginger. Only winged individuals have been recorded on tomato. These alates apparently have migrated from their normal hosts to tomato.

P. nigronervosa is the chief vector of banana bunchy-top disease and abaca bunchy-top disease (1). It also transmits the virus of southern celery mosaic (8).

Rhopalosiphum nymphaeae (Linnaeus)

This species breeds readily on taro. Only alates have been recorded on potato and pole bean. Further collecting may show whether this species is capable of breeding on these plants.

Rhopalosiphum pseudobrassicae (Davis)

The turnip aphid breeds in abundance on Chinese cabbage, daikon, and other crucifers. Gould (5) reported this species breeding on broccoli in Virginia in 1930. Only alates were found on tomatoes. This aphid is probably a recent introduction into the Territory.

R. pseudobrassicae transmits the viruses of bean mosaic, cauliflower mosaic and stock mosaic (8). It is also the vector of yellow dwarf of onion (12).

Toxoptera aurantii (Fonscolombe)

Recently this species has been found breeding freely on the flowers of mango at Kalihi, Oahu.

Petri has suggested that the "little-leaf" disease of citrus is spread by an aphid *Toxoptera aurantis* Boyer[1] (12) : 556.

[1] Probably a misprint for *T. aurantii;* Boyer and Fonscolombe refer to the same author, whose name was Boyer de Fonscolombe. (Ed.)

Vesiculaphis caricis (Fullaway)

This aphid has been reported breeding on a species of *Carex* (4). Only alates have been found by us on tomato. These winged aphids may have flown from their natural hosts to tomato.

Summary

New hosts, for Hawaii, are recorded of the following twenty species of aphids: *Amphorophora sonchi* (Oestlund), *Aphis gossypii* Glover, *Aphis maidis* Fitch, *Aphis medicaginis* Koch, *Aphis middletonii* Thomas, *Aphis rumicis* Linnaeus, *Aphis sacchari* Zehntner, *Brachycolus heraclei* Takahashi, *Cavariella capreae* (Fabricius), *Macrosiphum rosaefolium* Theobald, *Macrosiphum solanifolii* (Ashmead), *Micromyzus formosanus* (Takahashi), *Myzus circumflexus* (Buckton), *Myzus convolvuli* (Kaltenbach), *Myzus persicae* (Sulzer), *Pentalonia nigronervosa* Coquerel, *Rhopalosiphum nymphaeae* (Linnaeus), *Rhopalosiphum pseudobrassicae* (Davis), *Toxoptera aurantii* (Fonscolombe) and *Vesiculaphis caricis* (Fullaway).

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We are indebted to Dr. F. G. Holdaway for his direction in the preparation of this paper and to Professor E. O. Essig and S. H. Au for assistance in making the determinations. The technical names of the plants mentioned have been checked by E. Y. Hosaka.

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Thrips from Maui and Molokai[1]

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(Presented at the meeting of November 8, 1943)

A collection of thrips was made by Krauss at widely scattered localities on the islands of Maui and Molokai during the period from May 29 to June 13, 1943 and again on Molokai from October 8 to 12, 1943, and the specimens were examined by Sakimura. Since no extensive collections have been made on these two islands, very little of the thysanopterous fauna, especially of the introduced species in the cultivated lowlands, has been known. The present collection contributes somewhat toward a further knowledge. A complete list of species now known from these two islands is given at the end of the paper; 24 forms are listed from Maui and 25 from Molokai. The most significant discovery was of the establishment on Molokai of the California bean thrips (*Hercothrips fasciatus* [Perg.]), whose invasion into the Hawaiian Islands has long been feared.

Organothrips bianchii Hood

* Honouliwai, Molokai: *Colocasia esculenta* (taro), petioles.

* Halawa Valley, Molokai: *Colocasia esculenta* (taro), petioles.

Moderate and heavy infestations of this unique thrips were found at the respective localities. This species was first discovered on Oahu and Hawaii during 1939 (3) (7) and its distribution now includes Molokai.

Heliothrips haemorrhoidalis Bouché (greenhouse thrips)

Olinda, Maui: *Rubus penetrans,* leaves and stems.

Hypochaeris radicata (gosmore), leaves.

Peach, leaves.

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* Throughout this paper a single asterisk indicates that collection was made during October, 1943.

* Near edge of Waikolu Valley, Molokai: *Vaccinium calycinum* (ohelo), leaves.

A localized heavy infestation was found at Olinda on *Rubus penetrans,* which is a cultivated but escaped species, and on the two other plants growing nearby in a gulch with mixed undergrowth and a few trees. Another heavy infestation was found on ohelo, a native fruit shrub, in the rain forest at the edge of Waikolu Valley. Despite the fact that this species has been known in the Hawaiian Islands since 1892 (1), and it was stated as early as 1921 that "it is quite abundant in the forest areas of various islands" (5), actual records of collection were from Kauai, Hawaii, and Oahu only. There is an unpublished record that this species was collected from boysenberry (*Rubus loganobaccus* hybrid?) at the Haleakala (Maui) Substation of the Hawaii Agricultural Experiment Station in 1939 by Dr. F. G. Holdaway. These are apparently the first records from Maui and Molokai. All five plants are new Hawaiian host records.

Hercothrips fasciatus (Perg.) (bean thrips)

Kaunakakai, Molokai: *Argemone alba* var. *glauca* (prickly poppy), leaves, buds, and flowers.

This is apparently the first discovery of this species in the Hawaiian Islands. It was probably introduced from California on plant material, possibly oranges. This is the second immigrant thrips discovered within the past year, the first being *Frankliniella* sp. Verification has been requested of Mr. Dudley Moulton for the determination of *H. fasciatus.*

A very heavy infestation was found, on June 4, on several plants of this host growing together on the bank of a dry stream bed just outside of the town. The vegetation in the vicinity was typical of dry, weedy uncultivated areas, and there were few cultivated plants in the vicinity. Further examinations were made in June of the same host plant in other parts of Kaunakakai as well as quite extensively in the area between Hoolehua and the south coast, but no other infestation was found.

In October a far more extensive search of the island for this species was made. Known host plants including the prickly poppy, sow thistle (*Sonchus oleraceus*), cotton, bean, pea, and also many potential hosts were examined in Kaunakakai and vicinity, and in many other parts of the island but no thrips of this species were found. The original infestation in Kaunakakai apparently died out during the hot dry weather of summer, but there seems a bare possibility that the species will reappear during the next rainy season.

Hercinothrips femoralis (Reuter) (banded greenhouse thrips)

Although this species was not collected on these trips, there is an unpublished record that it was found at Wailua, Maui on young fruits of banana causing extensive silver and bronze scars. The specimens were collected by Mr. J. Shigeta in January, 1943 and forwarded by Dr. F. G. Holdaway for determination. This species has been known in the Hawaiian Islands since 1930 (12), but has only been recorded from Oahu, so that this is the first record from Maui. Although this thrips has frequently been collected from various greenhouse plants, collection from outdoor plants has been previously made only once—on *Emilia sonchifolia* (18). Two other new outdoor records are from *Plantago major* at Kalihi, Oahu, collected by Mr. W. C. Look in March, 1943, and from *Emilia sonchifolia,* on which they were flourishing, in a pineapple field at Waipio, Oahu in November, 1942. These records indicate that this species, as on the mainland, occasionally builds up high populations outdoors under certain conditions. Banana and *Plantago* are new Hawaiian host records.

Selenothrips rubrocinctus (Giard) (red-banded thrips)

Wailuku, Maui: *Mangifera indica* (mango), leaves.

Eastern Molokai: *Schinus terebinthifolius* (Christmas berry tree), leaves.

The infestation on mango was heavy. Although the occurrence of such a common species, known in the Hawaiian Islands since 1909 (6), might be expected on every island, specimens from Maui and Molokai have never been previously recorded. Hawaii and Lanai are still not on the distribution list.

Frankliniella sp.

Haiku, Maui: Hibiscus, flowers.

Olinda, Maui: *Rubus penetrans,* flowers.

Kaunakakai, Molokai: Hibiscus, flowers.

* *Ipomoea cairica* var. *lineariloba* (Molokai morning glory), flowers.

* *Gossypium brasiliense* (cotton), flowers.

* Near Kahualelepulu, Molokai: *Argemone alba* var. *glauca* (prickly poppy), flowers.

* Hoolehua, Molokai: *Argemone alba* var. *glauca* (prickly poppy), flowers.

Moomomi, Molokai: *Tribulus cistoides* (nohu), flowers.

This is the same species that was recorded under the name of *F.* near *occidentalis* (Perg.) when first discovered on Oahu during

August, 1924 (15). Evidence indicates that this must be a recent immigrant species from a source not yet known. This species is an extremely polyphagous feeder, mainly on flowers, and no known Hawaiian species has a comparably wide host range. The formal determination of the species has not yet been received from Dr. J. D. Hood. More details on its host range, distribution, populations, life history, and inability to transmit the yellow spot virus will be reported in other papers.

This species has now been discovered on Maui and Molokai, and its adaptability in a new territory is very significant. Although many flowers known to be its hosts were examined during June, it was found only on three plants at four places and the infestations were generally light except the one at the dry sandy beach of Moomomi. Since this is definitely a dry land species, the low general populations must have been due partly to the season and partly to the districts where collections were made. However, the second collection made on Molokai during October and additional collections from Maui made by Mr. K. I. Hanson and Dr. F. G. Holdaway indicate that this species is as common and abundant on these islands during the dry season as it is on Oahu. Heavy and moderate infestations were found by Mr. Hanson on hibiscus flowers at Lahaina in July and August, and at Mala and Haiku in October, and by Dr. Holdaway on eggplant flowers at Lahaina in August.

Taeniothrips simplex Morison (gladiolus thrips)

Haiku, Maui: Gladiolus, leaves.

A moderate infestation was found of the famous gladiolus thrips which has been established on Maui since 1932 (4). There was no opportunity to examine gladiolus on Molokai where its presence has not yet been reported.

Thrips hawaiiensis (Morgan) and **T. hawaiiensis** f. **imitator** Pr.

(Hawaiian thrips)

Kahakuloa, Maui: *Vitex trifolia* var. *simplicifolia* (polinalina), flowers.
Iao Valley, Maui: *Aleurites moluccana* (kukui), flowers.
Haiku, Maui: *Samanea saman* (monkeypod), flowers.
Nahiku, Maui: *Psidium guajava* (guava), flowers.
Hana, Maui: *Dioclea violacea* (maunaloa), flowers.
Olinda, Maui: *Rubus penetrans*, flowers.
Kaunakakai, Molokai: *Batis maritima*, flowers.
Hibiscus, flowers.
Calotropis gigantea (crown flower), flowers.
* *Ipomoea cairica* var. *lineariloba* (Molokai morning glory), flowers.

Mapulehu, Molokai: *Dioclea violacea* (maunaloa), flowers.

Near edge of Waikolu Valley, Molokai: Rose, flowers.

Kalae, Molokai: *Acacia confusa,* flowers.

* Hoolehua, Molokai: *Argemone alba* var. *glauca* (prickly poppy), flowers.

These are very common flower thrips in the Hawaiian Islands and were frequently collected from various hosts on these trips. Populations were generally high on these hosts except on the ones in the drier sections and on those collected during October. This indicates that their preferred habitats apparently are wet or shady areas which is quite contrary to the preference of the other flower thrips, *Frankliniella* sp. Specimens from Molokai have not been recorded before, but their distribution now definitely includes all the Hawaiian Islands. The record from Hawaii is of specimens collected from cotton at Kona during 1928 (8). These species are also widely distributed among the Pacific islands. New local host records are polinalina, kukui, monkeypod, maunaloa, *Rubus penetrans, Batis,* crown flower, Molokai morning glory, *Acacia confusa,* and prickly poppy.

These species were originally described under the name of *Euthrips hawaiiensis* Morgan from specimens collected at Honolulu during 1909 (10), but later were transferred by Moulton to the genus *Taeniothrips* (11), which is the familiar name to the local entomologists. Priesner subsequently separated them into two groups: one with non-segmented styles—*Thrips hawaiiensis;* and the other with 2-segmented styles—*Thrips hawaiiensis* f. *imitator* (16). Sakimura has long known that an incidental number of the local specimens have non-segmented styles but has used only the name of the original species instead of separate names, because Priesner's reference has not been available to be consulted. After critical examination of many local specimens collected on these trips as well as of other collections, it was found that the predominating species is *imitator* and it is desirable to use separate names to distinguish the two forms. In the June collection alone, 91 out of the 107 individuals were *imitator.* A mixed colony was sometimes found on a single host plant but always *hawaiiensis* was in lesser numbers and a pure colony of *hawaiiensis* has not yet been encountered. Among a series of *hawaiiensis,* the true form—styles of both antennae non-segmented — was scarce. The majority were transitional forms, such as individuals either with partially segmented styles of both antennae, or a 2-segmented style of one antenna and a partially segmented style of the other, or a non-segmented style of one and a partially segmented style of the other. In addition, another anomalous antenna rarely found was 6-segmented, with shorter total length, shorter and narrower third

segment without sense cone, prolonged fifth segment, and non-segmented style. One specimen with both antennae of this type and another with one antenna of this type and the other of the normal 8-segments were found among the present material. It will be desirable to run a breeding experiment of these different forms to know the true interrelationships between them, that will provide a ground for clarifying the nomenclature of these two forms as is apparently necessary on the basis of the field population data.

Thrips tabaci Lind. (onion thrips)

Iao Valley, Maui: Onion, leaves.
Haiku, Maui: Onion, leaves.

Thrips (Isoneurothrips) australis (Bag.)

* Near edge of Waikolu Valley, Molokai: *Eucalyptus* sp., flowers.

A large number of specimens was collected from the flowers. This species was first discovered on Oahu during 1938 (2), and is rather common on *Eucalyptus* flowers. This is the first record from Molokai.

Thrips (Isoneurothrips) sp.

Near edge of Waikolu Valley, Molokai: *Broussaisia* sp., flowers.

A heavy infestation of this probably indigenous species was found on this native plant in the rain forest area at 3500 feet elevation. This species is very closely related to the indigenous *T.* (*I.*) *antennatus* (Moulton) but is undoubtedly distinct from all the Hawaiian species of this genus and probably is an undescribed species. The final determination has been requested of Mr. Moulton whose report is expected in the near future.

Thrips (Isoneurothrips) sp.

* Near edge of Waikolu Valley, Molokai: *Raillardia molokaiensis* (naenae), leaves.

A heavy infestation of another probably indigenous species was found on another native plant in the rain forest within a short distance of the site where the preceding species was collected. The present species is also distinct from all Hawaiian species of this genus but somewhat resembles *T.* (*I.*) *dubautiae* (Moulton) and probably is an undescribed species. However, final determination is withheld until further study will be made.

Thrips (Microcephalothrips) abdominalis Cwfd. (composite thrips) Iao Valley, Maui: *Tithonia diversifolia* (tree tithonia), flowers.

Infestation was moderate. The first record from Maui is of a collection made at Makena during 1940 on a previous trip by Krauss (9). Another moderate infestation was found by Mr. B. Kumabe on dahlia flowers at Wailuku, Maui in October, 1943. Specimens were forwarded by Dr. F. G. Holdaway for determination. This species has been known in the Hawaiian Islands since 1926 (11) and is distributed on Oahu and Kauai also.

Oedemothrips laticeps Bag.[3]

* Near edge of Waikolu Valley, Molokai: sweeping.

A single specimen was collected by sweeping among various shrubs and trees in the rain forest. The type specimens of this indigenous species were collected in 1896 and 1900 at three localities on Oahu (1). As far as published records are concerned, the next specimen was collected in 1935 again from Oahu (13), so that this is the fifth collection and the first record from Molokai.

Hoplothrips flavitibia Moulton

Iao Valley, Maui: *Aleurites moluccana* (kukui), under bark of dead log.

Many specimens, including immature stages, were collected in a typical habitat for this common phloeophilous (bark-loving) species of the Hawaiian forest. All except one female were brachypterous forms. According to published records, this is the first record from Maui as it has been known only from Oahu where the type specimens were collected in 1927 (11). Since this species is also distributed on other Pacific islands (14), there is little doubt that it will be found on other islands of the Hawaiian group.

Haplothrips fusca Moulton

Kaunakakai, Molokai: *Batis maritima*, flowers.

Near edge of Waikolu Valley, Molokai: *Cladium angustifolium* (a sedge), flowers.

Moderate infestations were observed at both places. *Batis* was growing in a shoreside swamp and *Cladium* was found along a roadside in the rain forest. The type specimens were collected from *Batis maritima* on Oahu during 1927 (11), and the second collection was made in a wind trap on Molokai during 1933 (17)

[3] This species has been referred to *Nesothrips hawaiiensis* Kirk. See paper by F. A. Bianchi in this issue (p. 31) [Ed.].

but the host was not known there. The next specimens were caught, again on the type host, at Koko Head, Oahu during 1940. *Batis* and *Cladium* are the only known hosts and the former seems to be the preferred one. It is interesting to note that a colony mixed with *Haplothrips gowdeyi* was observed at Koko Head and also on an unknown host at Kaunakakai on these trips.

Haplothrips gowdeyi (Frank.) (black flower thrips)

Hana, Maui: *Plantago major* (plantain), flowers.
Dioclea violacea (maunaloa), flowers.
Wailuku, Maui: *Cenchrus* sp. (sandbur), flowers.
Kaunakakai, Molokai: *Commelina diffusa* (honohono), flowers.
Calotropis gigantea (crown flower), flowers.
Near edge of Waikolu Valley, Molokai: *Taraxacum officinale* (dandelion), flowers.
Kawela, Molokai: Tomato, leaves.
Cenchrus sp. (sandbur), flowers.
Zinnia pauciflora, flowers.
Moomomi, Molokai: *Tribulus cistoides* (nohu), flowers.
Hoolehua, Molokai: *Verbesina encelioides* (golden crown beard), flowers.
* *Argemone alba* var. *glauca* (prickly poppy), flowers.

This is an extremely common and abundant thrips in the Hawaiian Islands and many specimens were collected from various hosts on these trips. The first specimen, mentioned under the name of *Anthothrips usitatus* Bag., was collected on Hawaii in 1892 (1), and many have been collected since from all the islands. This species is also widely distributed among the Pacific islands. Maunaloa, crown flower, dandelion, *Zinnia pauciflora,* nohu, and prickly poppy are new local host records.

LIST OF THRIPS KNOWN FROM MAUI AND MOLOKAI

Terebrantia	Maui	Molokai
Aeolothrips fasciatus (Linn.)	×	
Organothrips bianchii Hood		×**
Heliothrips haemorrhoidalis Bouché	×**	×**
Hercothrips fasciatus (Perg.)		×**
Hercinothrips femoralis (Reuter)	×**	
Selenothrips rubrocinctus (Giard)	×**	×**
Anaphothrips swezeyi Moulton		×
Frankliniella sp.	×**	×**
Taeniothrips alliorum Pr.	×	×
Taeniothrips frici (Uzel)	×	
Taeniothrips simplex Morison	×	
Thrips hawaiiensis (Morgan)	×	×**

Thrips hawaiiensis f. imitator Pr.	×	×**
Thrips nigropilosus Uzel	×	
Thrips saccharoni Moulton		×
Thrips tabaci Lind.	×	×
Thrips (Isoneurothrips) australis (Bag.)		×**
Thrips (Isoneurothrips) multispinus Bag.		×
Thrips (Isoneurothrips) sp.		×**
Thrips (Isoneurothrips) sp.		×**
Thrips (Microcephalothrips) abdominalis Cwfd.	×	
Plesiothrips panicus (Moulton)[4]		×
Merothrips hawaiiensis Moulton		×
Tubulifera		
Dermothrips hawaiiensis Bag.	×	
Oedemothrips laticeps Bag.		×**
Hoplothrips angusticeps (Bag.)		×
Hoplothrips dubius (Bag.)		×
Hoplothrips flavipes (Bag.)	×	
Hoplothrips flavitibia Moulton	×**	
Hoplothrips hawaiiensis Moulton	×	
Hoplothrips intermedius (Bag.)	×	
Hoplothrips lanaiensis (Bag.)		×
Hoplothrips mauiensis Moulton	×	
Hoplothrips ovatus (Bag.)	×	
Hoplothrips swezeyi Moulton	×	
Macrophthalmothrips hawaiiensis Moulton	×	
Karnyothrips melaleuca (Bag.)		×
Haplothrips fusca Moulton		×
Haplothrips gowdeyi (Frank.)	×	×
Aleurodothrips fasciapennis (Frank.)		×
Phloeothrips mauiensis Moulton	×	

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** Heretofore unrecorded species on the island.

[4] As Dr. J. D. Hood originally suggested in private correspondence, this species was found to fit fully the description of *P. perplexus* (Beach), but since specimens of *P. perplexus* are not now available for comparison, establishment of the synonym is withheld until such examination can be made. See Hood, Rev. de Ent. **6**(2): 258, 1936.

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Thrips From Kauai[1] [2]

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(Presented at the meeting of December 13, 1943)

Forty lots of thrips specimens were collected during the period from August 12 to September 15, 1943 by one of the authors (T.N.), at various localities along the drier section of the lowlands from Wailua to Kekaha and in the wet highlands of Kokee. The specimens were examined by the other author (K.S.). Collections were most concentrated at Hanapepe where almost one-half of the material was collected. The cultivated plants and nearby weeds were mainly examined, particularly to search for the presence of *Hercothrips fasciatus* (Perg.) which was recently discovered on the island of Molokai (13) and to ascertain the distribution and population status of *Frankliniella* sp., another recent immigrant species. There was no indication of the presence of the former species there, but the latter was widely distributed and very abundant. Very little of the thysanopterous fauna, especially of the introduced species in the cultivated lowlands of this island has been known; only seven species had been recorded up to 1937 when one of the authors (K.S.) (11) made the first extensive collection and added 13 species to its list. The present collection added seven more heretofore unrecorded species. A complete list of species now known from this island is given at the end of the paper.

Heliothrips haemorrhoidalis Bouché

Kapaa: Hibiscus, flowers.[3]

Kokee: Gladiolus, leaves.

A light infestation of this thrips along with an even lighter one of *Taeniothrips simplex* was found on a few gladiolus plants growing under semi-wild conditions within the forest area. A single specimen was also collected from hibiscus. This species is apparently a forest or wetland species. Gladiolus is a new local host

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[2] Acknowledgment is due to Messrs. K. I. Hanson and K. Ito who collected, upon request, some of the specimens.

[3] Collected by Mr. K. Ito in June, 1943.

record. These are the second collections on Kauai; the first specimen was collected in 1895 by Dr. R. C. L. Perkins (1).

Selenothrips rubrocinctus (Giard)

Hanapepe: *Eugenia cumini* (Java plum), leaves.
Litchi chinensis (litchi), leaves.

Severe injuries were observed on a young Java plum where the populations were extremely high. Infestation was very low on a litchi growing in the vicinity. Litchi is a new local host record.

Chirothrips fulvus Moulton

Hanapepe: *Paspalum dilatatum* (dallis grass), flower sheaths.

A few specimens were collected from within the half-open flower sheaths. This is the first collection from Kauai and the host is a new record. Only three collections have been made, all from Oahu, in the past; from *Paspalum orbiculare* in 1930 (8), on wind traps in 1935 (4), and from the same host again in 1938 (12). Although the species was described from specimens collected from the Hawaiian Islands, it probably has been introduced from the mainland for its presence was recently reported from Texas (6).

Chirothrips spiniceps Hood

Hanapepe: *Echinochloa crusgalli* (barnyard grass), flower sheaths.

A light infestation was found within the half-open flower sheaths of the plants growing in a rice patch. This is the second collection on Kauai and the host is a new record. The Hawaiian species was described under the name of *C. sacchari* Moulton from specimens collected on Oahu in 1929 (8), but was subsequently recorded as a synonym of *C. spiniceps* (5) (6), often abundant and widely distributed in southern United States as well as along the Atlantic coast and once observed as having been abundant on sugar cane in Arizona. This species must have been introduced from the mainland.

Scirtothrips antennatus Moulton

Upper Kekaha: Carrot, leaves.

A single specimen was collected. This species has been known in the Hawaiian Islands since 1930 (9), and is distributed on Oahu also. Panax is the preferred host, but there are two other known host plants. The present one is a new record.

Leucothrips piercei (Morgan)

Wailua: Bush bean, leaves.
Waimea: Bush bean, leaves of seedlings.
Upper Kekaha: Carrot, leaves.

Light infestations of this species, a common thrips on various vegetables and ornamental herbs, were found at each of the localities, making this the second collection from Kauai. This species has been known in the Hawaiian Islands since 1931 when the first specimen was collected from cocklebur (*Xanthium saccharatum*) at Moanalua, Oahu. Although Mr. Dudley Moulton determined the species from the specimen mentioned above, he failed to list it in his papers of Hawaiian thrips. The known distribution is only Oahu and Kauai.

Dendrothripoides ipomeae Bag.

Lihue: Sweet potato, leaves.

A light infestation causing slight injuries was observed in a large planting of sweet potato. This is the first record from Kauai. This species was only quite recently, in 1940, discovered in the Hawaiian Islands, at Kailua, Oahu (2). Although an infestation on sweet potato was first found at Ewa, Oahu in 1941, it was stated that there were no visible injuries (3). However, one of the authors (T.N.) observed severe injuries as scars and malformation at the growing terminals on sweet potato at the University farm in Manoa, Oahu in May, 1942, and moderate injuries on lettuce growing nearby. The determination of the species was made by Dr. J. D. Hood. In addition to the above records, the other author (K.S.) found a moderate infestation on yam (*Dioscorea* sp.) at Waialae, Oahu in September, 1943, and collected a single specimen from koali (*Ipomoea congesta*) at Kahaluu, Oahu in October, 1942. These records indicate that this species must be rather common and generally distributed, at least on Oahu.

Anaphothrips (Chaetanaphothrips) orchidii (Moulton)

Hanapepe: *Litchi chinensis* (litchi), leaves.

A single specimen was collected. This is the first collection from Kauai and the host is a new record. This species has been known in the Hawaiian Islands since 1926 (7) but reported only from Oahu. This is a rather common thrips and has a fairly wide host range; bougainvillea flowers were recently found moderately infested at Hauula and Manoa, Oahu, and breeding was also observed on leaves of *Emilia sonchifolia* under confinement.

Scolothrips sexmaculatus (Perg.)

Waimea: Bush bean, leaves of seedlings.

Thunbergia grandiflora (thunbergia), leaves.

A few specimens were collected on both plants on which moderate infestations of mites were found. The present collection is

the first record from Kauai. This species has been known in the Hawaiian Islands since about 1910 (1) but reported only from Oahu. Although collections have been recorded only twice in the past, a long series of unpublished data indicates that this is one of the common thrips on Oahu and that wherever plants, especially cultivated plants, are infested with mites, the thrips populations are gradually built up. Such an association of this thrips with mite was found not only in the dryland but also in wetland areas.

Frankliniella sp.

Kapaia: Eggplant, flowers.
Lihue: *Melaleuca leucadendron* (paper bark), flowers.
Upper Wahiawa: *Aster* sp., flowers.
Hanapepe: Hibiscus, flowers.
Momordica balsamina (balsam apple), flowers.
Salvia leucantha (a sage), flowers.
Crotalaria mucronata (*C. saltiana* of the Hawaiian authors) (rattle pod), flowers.
Amaranthus hybridus (spleen amaranth), flowers.
Sesbania grandiflora (sesban), flowers.
Canna, flowers.
Abutilon molle (wild abutilon), flowers.
Erigeron albidus (horseweed), flowers.
Ipomoea congesta (*I. insularis* of the Hawaiian authors) (koali), flowers.
Makaweli: Hibiscus, flowers.[4]
Waimea: Pole bean, flowers.
Eggplant, flowers.
Waimea beach: *Ipomoea pes-caprae* (beach morning glory), flowers.
Tribulus cistoides (nohu), flowers.
Kekaha: *Leucaena glauca* (koa haole), flowers.
Prosopis chilensis (kiawe), flowers.
Kokee: *Buddleia japonica* (summer lilac), flowers.

This is the same species mentioned in the previous papers (10) (13). In a discussion with Mr. N. L. H. Krauss, he remarked that some specimens which he thought were this species were among his Kauai thrips collection of October, 1942. This is presumed to be the first record of this thrips from Kauai. The present collection showed that this species is as widely distributed and as common and abundant there as it is on Oahu. The largest number of specimens of a single species in the whole collection was of this thrips which indicates that this is the commonest thrips in the lowland

[4] Collected by Mr. K. I. Hanson in September, 1943.

during the dry season. As no specimen was collected in 1937 (11), the establishment on Kauai must have been made since this date.

Through the effort of Dr. F. G. Holdaway, specimens of this species from Hawaii were recently made available for examination. They were collected from eggplant flowers at Kona in September, 1943. Now, the known distribution includes all islands of the Hawaiian group except Lanai.

Infestations were heavy on balsam apple, rattle pod, koali, hibiscus at Makaweli, pole bean, eggplant at Waimea, and beach morning glory; moderate on eggplant at Kapaia, sesban, canna, wild abutilon, nohu, and koa haole; and light on the others. However, the species was predominant on every host plant examined except paper bark, *Aster* sp., amaranth, canna, horseweed, koa haole, and summer lilac. Populations were generally high in the drier sections between Hanapepe and Kekaha, and low in the slightly wetter sections north of Lihue and at Kokee. The predominating thrips on flowers in the drier areas was the present species; but in the wetter areas, *Thrips hawaiiensis* and *T. hawaiiensis* f. *imitator*. These indications for a differential preferred habitat of these two thrips were also observed on Oahu, Maui, and Molokai (13). All host plants except eggplant, hibiscus, and nohu are new host records.

Taeniothrips alliorum Pr.

Upper Kekaha: Onion, leaves.

Relatively high populations for this species were found at upper Kekaha. A wetland species, it seldom establishes high populations in the dry lowlands. This species has been known in the Hawaiian Islands since 1930 (8) and reported from all the islands except Hawaii. It probably has been introduced from the Orient, where it is especially common in Japan, Korea, Loochoo, and Formosa.

Taeniothrips simplex Morison

Kokee: Gladiolus, leaves.

Tritonia crocosmaeflora (montbretia), flowers.

Infestations were light on gladiolus but moderate on montbretia and few typical scars were found on both plants growing under semi-wild conditions within the forest area. Gladiolus was examined for this thrips at several places on the previous trip (11) but its presence could not be found at that time. Apparently this is the first record from Kauai. The known distribution now includes all of the Hawaiian Islands except Molokai and Lanai. This species is quite a specific feeder and only very few normal, natural host plants are known in the other countries where it occurs. Montbretia

is one of these few plants and collection from it, a new local host record, is very interesting.

Thrips hawaiiensis (Morgan) and **T. hawaiiensis** f. **imitator** Pr.

Kapaa: Hibiscus, flowers.[5]
Upper Wailua: Bell pepper, flowers.
Wailua: Bush bean, flowers and leaves.
Lihue: *Scaevola frutescens* var. *sericea* (beach naupaka), flowers.
Melaleuca leucadendron (paper bark), flowers.
Upper Wahiawa: *Aster* sp., flowers.
Hanapepe: Bush bean, flowers.
Crotalaria mucronata (rattle pod), flowers.
Canna, flowers.
Telosma cordata (pakalana), flowers.
Waimea: Pole bean, flowers.
Kekaha: *Leucaena glauca* (koa haole), flowers.
Kokee: *Buddleia japonica* (summer lilac), flowers.
Gladiolus, leaves.

These flower thrips were very common and abundant and collected from various hosts throughout the areas covered by the collection. Infestations were heavy on bell pepper, beach naupaka, pakalana, and summer lilac; moderate on hibiscus, bush bean at Wailua and Hanapepe, paper bark, canna, and koa haole; and light on the others. Although these species showed some preference for certain hosts, their populations were generally high in the wetter sections or under shady surroundings and were low in the drier sections between Hanapepe and Kekaha. Bell pepper, bush and pole bean, beach naupaka, paper bark, *Aster* sp., pakalana, summer lilac are new local host records. Among 152 specimens examined, there were 92 *imitator,* 55 *hawaiiensis,* and 5 others with anomalous antennae.

Thrips tabaci Lind.

Wailua: Bush bean, leaves.
Upper Wahiawa: *Aster* sp., flowers.
Waimea: Bush bean, leaves of seedlings.
Kekaha: *Leucaena glauca* (koa haole), flowers.
Upper Kekaha: Carrot, leaves.
Onion, leaves.

Infestations were either very light or light on bean and carrot on which *Leucothrips piercei* predominated. A moderate infesta-

[5] Collected by Mr. K. Ito in June, 1943.

tion along with a subincidental number of *Taeniothrips alliorum* was found on onion at upper Kekaha. Very few were collected from *Aster* sp., a new local host record, and koa haole.

Thrips (Isoneurothrips) australis (Bag.)

Kokee: *Buddleia japonica* (summer lilac), flowers.

A single specimen was collected in the rain forest area. This is the first record from Kauai. As in Australia, the native territory of this species, there seem to be many other host plants besides *Eucalyptus,* a preferred host, in the Hawaiian Islands. Summer lilac is a new local host record.

Plesiothrips panicus (Moulton)

Hanapepe: *Paspalum dilatatum* (dallis grass), flower sheaths.

A single specimen was collected from within half-open flower sheaths. This is the second collection on Kauai and the host is a new record. The earliest collection of this species, one of the very common grass thrips, in the Hawaiian Islands was made in 1928 (8) and its known distribution also includes Oahu and Molokai. This species is probably a synonym of *P. perplexus* (Beach) (13).

Haplothrips gowdeyi (Frank.)

Upper Wahiawa: *Aster* sp., flowers.
Hanapepe: *Salvia leucantha* (a sage), flowers.
Crotalaria mucronata (rattle pod), flowers.
Amaranthus hybridus (spleen amaranth), flowers.
Mimosa pudica (sensitive plant), flowers.
Carrot, flowers.
Canna, flowers.
Erigeron albidus (horseweed), flowers.
Echinochloa crusgalli (barnyard grass), flower sheaths.
Paspalum dilatatum (dallis grass), flower sheaths.
Waimea beach: *Tribulus cistoides* (nohu), flowers.
Upper Kekaha: Carrot, leaves.
Kokee: *Buddleia japonica* (summer lilac), flowers.

This common and very polyphagous thrips was frequently collected from cultivated plants and weeds throughout the area covered by the present collection. Infestations were heavy only on amaranth which seems to be a preferred host; moderate on *Aster* sp., horseweed, and nohu; and light on the others. *Aster* sp., *Salvia leucantha,* spleen amaranth, sensitive plant, canna, barnyard grass, dallis grass, nohu, and summer lilac are new local host records.

LIST OF THRIPS KNOWN FROM KAUAI

Terebrantia

Heliothrips haemorrhoidalis Bouché
Selenothrips rubrocinctus (Giard)
*Chirothrips fulvus Moulton
Chirothrips spiniceps Hood
Limothrips cerealium Halid.
Scirtothrips antennatus Moulton
Leucothrips piercei (Morgan)
*Dendrothripoides ipomeae Bag.
Anaphothrips swezeyi Moulton
*Anaphothrips (Chaetanaphothrips) orchidii (Moulton)
*Scolothrips sexmaculatus (Perg.)
*Frankliniella sp.
Taeniothrips alliorum Pr.
*Taeniothrips simplex Morison
Thrips hawaiiensis (Morgan)
Thrips hawaiiensis f. imitator Pr.
Thrips saccharoni Moulton
Thrips tabaci Lind.
*Thrips (Isoneurothrips) australis (Bag.)
Thrips (Isoneurothrips) multispinus Bag.
Thrips (Isoneurothrips) spp. (3 species)[6]
Thrips (Microcephalothrips) abdominalis Cwfd.
Plesiothrips panicus (Moulton)

Tubulifera

Dermothrips hawaiiensis Bag.
Karnyothrips melaleuca (Bag.)
Haplothrips gowdeyi (Frank.)

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* Heretofore unrecorded species on Kauai.
[6] Refer to the previous paper (11).

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The Kou Moth, Ethmia colonella Walsm., in Hawaii

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(Presented at the meeting of February 8, 1943)

This moth is attached to the "kou" tree, *Cordia subcordata* Lamarck. It was described in the family Oecophoridae by Walsingham in the Fauna Hawaiiensis, **1** (5) : 507, 1907, from 19 specimens collected by Perkins in 1896 in Honolulu. Walsingham considered it the same species as the two moths collected by Blackburn prior to 1882, which were determined incorrectly by Butler as *Azinis hilarella* Walker (Ent. Mo. Mag., **19**: 180, 1883). Butler quotes Blackburn as saying: "I have twice taken this insect, though at long intervals, each time it was apparently attracted by light, but seemed very sluggish, and apparently satisfied to sit and look at the light from a distance". The Perkins specimens mentioned above, were from an unrecorded cultivated plant in Honolulu, and the statement was made that it was probably an introduced species.

Since 1906, it has been known that *Cordia subcordata* was its host plant, there being specimens in the H.S.P.A. collection reared from this plant by Terry, August and December, 1906, in Honolulu. In Proc. Haw. Ent. Soc., **6** (3) : 373, 1927, Swezey records finding a *Cordia subcordata* tree infested with *Ethmia* caterpillars at Kahului, Maui, October 16, 1926. Several moths were reared by Pemberton from an infested *Cordia* tree at Black Point, Honolulu, November 20, 1935. The specimens now exhibited were reared February 4, 1943 from caterpillars brought in by Dr. Lyon from a young infested *Cordia* tree in Foster Garden, Honolulu. Furthermore, it is certainly the moth whose caterpillars were referred to by Dr. Hillebrand in "Flora of the Hawaiian Islands": 321, 1888, where, under *"Cordia subcordata"*, he says: "Along the seashore here and there; formerly much planted by the natives round their houses, but now almost exterminated by the ravages of a small moth. . . . It ranges all the way from the Hawaiian Islands to Madagascar and Zanzibar, and would seem to have accompanied the Malayo-Maori race in their migrations, a reason for which may be found in the large shade afforded by its broad crown, particularly valuable in a littoral tree. The wood, rather soft but durable, is much prized for cabinet work, cups and dishes, exhibiting wavy ribbons of light and dark brown when polished". It was a favorite wood with the Hawaiians for making calabashes. Since 1906, and probably since Hillebrand's time, no trees have been able to grow

large enough for this purpose. They are always kept stunted on account of the caterpillars of *Ethmia colonella* feeding on the young terminal foliage and checking the growth of the tree. In fact, the tree is so scarce that only an occasional stunted example is now seen.

The caterpillars are protected by webs. The full-grown caterpillar is about 22 mm. long; black, with the dorsal and lateral surfaces speckled with numerous small irregular-shaped light yellow spots, a median dorsal pair of closely-parallel interrupted light yellow lines, laterally the spots are assembled in a distinct broken stripe just above the line of spiracles, which are small dark and nearly circular; cervical shield black with anterior margin widely light yellow and a median light yellow line; head black; head, cervical shield and dorsum with long slender black setae. Four pairs of slender abdominal prolegs.

The white cocoons are elongate oval, made rather flat on the surface of a leaf or other object. The pupa is 10 mm. long; uniformly reddish brown, surface smooth; wing and leg cases extend to the posterior margin of the fourth abdominal segment; cremaster has two stout spines situated ventrad a little forward from the apex of the abdomen and projected forward at a 45 degree angle, having numerous slender hooks to hold to the silk of the cocoon. This feature of the pupa distinguishes it from the pupa of any other moth in Hawaii. The caterpillar, too, is distinct from any other occurring in Hawaii. The pimpline parasite *Ephialtes hawaiiensis* (Cameron) has been recorded from the pupa, according to Perkins.

In 1920, two moths were collected by Kusche at Kaholuamano, Kauai. Hence, it is known on the three islands Oahu, Maui and Kauai, and no doubt would also be found on the other islands of the Hawaiian group if the *Cordia* trees were found and examined there.

Two or three other species of *Cordia* are planted in Honolulu and other localities, but *Ethmia colonella* has not been found feeding on any of them.

All along we have speculated on where *Ethmia colonella* might have come from, as we had not learned of any records of its occurrence in other localities. Just lately in searching the literature for other species of *Ethmia* and their habitats, I found that *Ethmia praeclara* was described from Lombok by Meyrick in 1910. It is a species which differs from *colonella* in only a few minor details. In the same paper (Trans. Ent. Soc. London, 1910: 461), he decribes three other species of *Ethmia* from Solomon Islands, Malay States and Queensland, respectively, which are also only slightly different from *colonella*. Nothing is given as to food plants. Could it be possible that these species are also to be found attached to

Cordia? Also, in this same paper, Meyrick records our *colonella* from Kei Islands. These islands are a little south of the western part of New Guinea. This seems a very unlikely place for *colonella* to migrate from to Honolulu. Perhaps we may venture the opinion that some future entomological explorations will discover it on some of the nearer intervening islands.

The family name *Ethmiadae* has been used by Busck and Meyrick for *Ethmia* and related genera. (See Journ. Bombay Nat. Hist. Soc., **19**: 422, 1909, and Proc. Ent. Soc. Washington, **12**: 53, 1910)

Later note: It is of interest to record that observations on the above *Cordia subcordata* tree at Foster Garden, at other times during the year, showed that there had been no recurrence of the earlier severe infestation. In September the tree had quite recovered from the early infestation and made a fine growth. Only two caterpillars were found by careful search. Four months later the tree was in fine flourishing condition, with no evidence of injury by *E. colonella* caterpillars. It will be of interest to continue observations and ascertain how long a period elapses before another severe infestation occurs on this tree, and to determine if possibly this moth has seasonal recurrences.

Synonomy of Euxoa hephaestaea (Meyrick) (Lep.)

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(Presented at the meeting of February 8, 1943)

Agrotis hephaestaea Meyrick, Fauna Hawaiiensis, **3**: 346, 1904.
Euxoa diplosticta Hampson, Ann. Mag. Nat. Hist., VIII, **4**: 368, 1909.
Euxoa wikstroemiae Swezey, Proc. Haw. Ent. Soc., **4**: 377, 1920.

Meyrick described *hephaestaea* from 14 specimens collected by Perkins in N.W. Koolau range, Oahu, July, 1901. Hampson described *diplosticta* from a single male collected by Perkins at Waialua, Oahu, without date. I suspect that this specimen was one from the same lot that Meyrick worked with, for the region where Perkins collected in N.W. Koolau range was above the Waialua plantation, and it is possible that a specimen (or maybe more of them) was labelled "Waialua" as there is a specimen labelled "Waialua" in the H.S.P.A. collection which is undoubtedly from the same lot. Swezey described *wikstroemiae* from two females reared

from caterpillars found on a *Wikstroemia* bush in the vicinity of Puu Kapele, Waimea Canyon, Kauai, Feb. 14, 1915. These two specimens agree with Hampson's description of *diplosticta* and have the two black spots which Hampson describes on each side of vein 5 near termen of forewing. These spots are not mentioned in Meyrick's description, and no doubt were not present, for in a series of specimens at the Bishop Museum, collected more recently, some have these spots while they are lacking in others.

Of the Bishop Museum series, 15 specimens were collected by Kusche in 1919 and 1920, at several localities on Kauai: Kokee, Alakai Swamp, Kaholuamano and Olokele; and one specimen was collected by Dr. C. M. Cooke, Jr. at Wailua, Kauai in 1925. This series of specimens has a gradation in color: some ferruginous like Meyrick's *hephaestaea* and others with shades of gray like Hampson's *diplosticta,* and some of these latter have the two black spots near the termen. Thus is demonstrated the synonomy of the species. Also at the Bishop Museum are three specimens from Molokai: one reared from *Wikstroemia* at Waikolu, 1925 and two taken at light at Kainalu, 1927, all by Swezey. These three are of the ferruginous type of coloration.

Furthermore, while at the U. S. National Museum in 1938, I noted 20 specimens labelled *Euxoa diplosticta* Hampson which were obtained from Mr. B. Preston Clark, who had received them from Kusche who was collecting for him on Kauai in 1919 and 1920. These specimens are not labelled, but are undoubtedly of the same lot as those from Kauai, at the Bishop Museum, mentioned above. They exhibit the same variations in color as the latter. Some of them have the two black spots near termen, and some lack them. There was also besides these a single specimen collected by Ashmead and labelled *"hephaestaea".* (I assembled all the specimens together with the latter name.)

The caterpillar is distinctly different from other known agrotid caterpillars in Hawaii. I have found them on *Wikstroemia* at various localities on Oahu: Oct. 25, 1914, on the ridge back of Alewa Heights; April 30, 1916, on Waialae-nui ridge; July 9, 1916, on Mt. Kaala; Feb. 8, 1925, at Malamalama. Success was not had in rearing these, which is often the case in bringing caterpillars from the mountain forests, on account of failure to bring enough of their food plant, or failure to keep it in fresh condition for them to feed on till maturity, or often the difficulty or inconvenience of making a special trip back for more fresh foliage.

From the above records, this moth is now known to occur on Kauai, Oahu and Molokai. No doubt it will yet be found on the other Hawaiian Islands, as its food plant, *Wikstroemia,* is known at least on Maui, Lanai and Hawaii.

Notes on Zaischnopsis sp., an egg-parasite of Holochlora japonica in Hawaii

BY O. H. SWEZEY

Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of October 11, 1943)

This parasite of *Holochlora japonica* (Brunn.) eggs was first observed by Mr. E. M. Ehrhorn ovipositing in a cluster of *Holochlora* eggs in his garden in Manoa Valley, May 12, 1938. From these eggs, 14 female *Zaischnopsis* issued between July 1 and August 1. Eight of the parasites issued on the same day, July 27. Thus the life cycle from egg to adult was about 10 or 11 weeks.

The parasites of the new generation were supplied with a fresh egg cluster of *Holochlora,* and oviposition occurred August 3 to 6. From this, 42 adult *Zaischnopsis* issued September 20 to November 4. The most of them (33) issued September 24 to October 10. This would indicate an average life cycle of seven to nine weeks, with a maximum of 13 weeks.

From another cluster of *Holochlora* eggs brought in by Mr. Ehrhorn, 11 *Zaischnopsis* issued September 6 to November 6. From an egg cluster found in hibiscus twig by Mr. Swezey, October 22, 1939, 15 *Zaischnopsis* issued, some of them at greatly delayed intervals.

In all of above cases every specimen was a female. A female specimen was collected by Swezey, October 8, 1939, in the Waianae Mts. near Puu Hapapa, which is the only record outside of Manoa Valley where first discovered.

The first record of this insect in the Proceedings of the Hawaiian Entomological Society was under the name *Anastatus.* (**10**: 187, 192, 1939). Specimens were submitted to Mr. A. B. Gahan, U. S. Bureau of Entomology, who pronounced it an undoubtedly new species of *Zaischnopsis,* a genus related to *Anastatus.*

Keys to Some Lepidopterous Larvae Found in Gardens and Homes in Hawaii*

BY O. H. SWEZEY

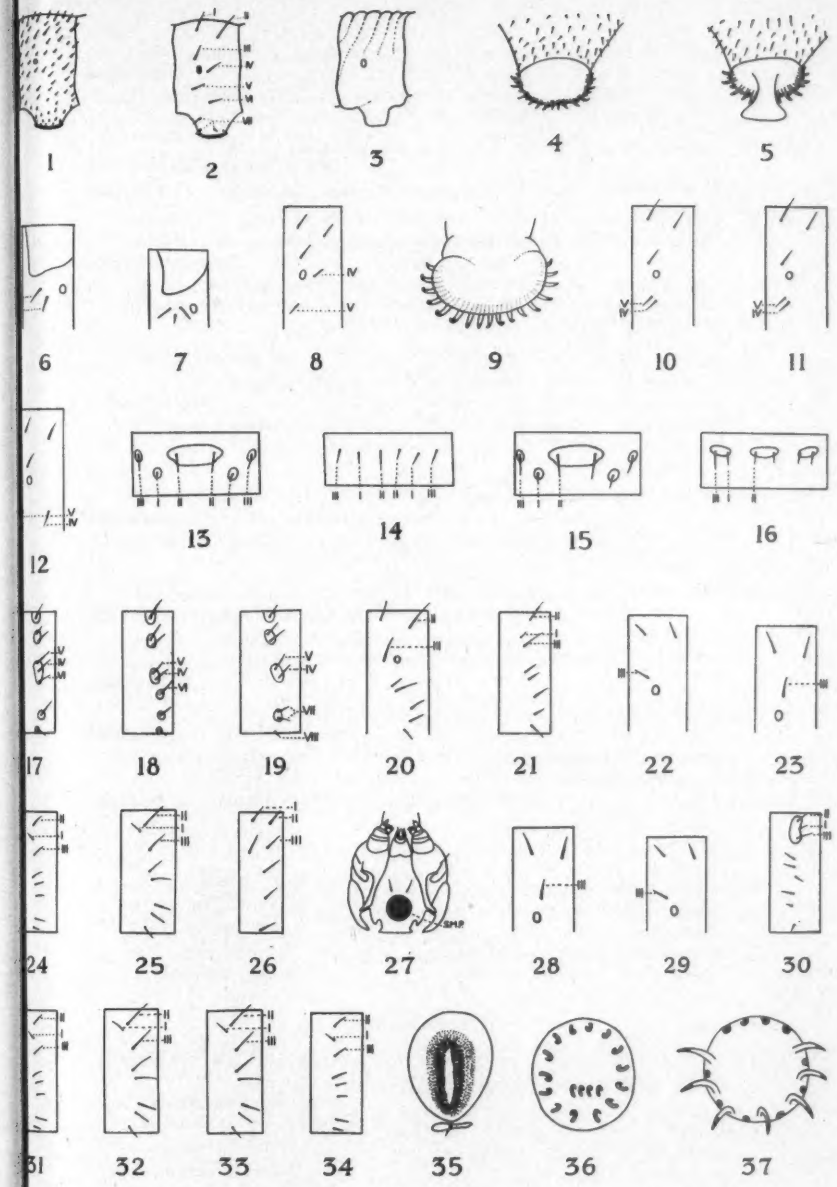
Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of August 9, 1943)

KEY TO FAMILIES

1. Caterpillars large, more than two inches; a long pointed dorsal horn on 8th abdominal segment ..... **Sphingidae**
   Caterpillars less than two inches 2
2. A pair of long soft moveable black horns or appendages on mesothorax, a shorter pair of similar appendages on 8th abdominal segment ..... **Danaidae**
   Without above appendages; body more or less hairy and with the usual setae represented by branching spines; skin minutely shagreened ..... **Nymphalidae**
   Not as above 3
3. Body with numerous short secondary setae (See fig. 1) 4
   Body without numerous short secondary setae (See fig. 2) 5
4. Body cylindrical, not depressed, segments divided into 6 or fewer annulets; crochets in a continuous mesoseries not interrupted by a spatulate lobe (See figs. 3, 4) ..... **Pieridae**
   Body depressed, fusiform (spindle-shaped), segments not divided into annulets; crochets in a mesoseries interrupted at center by a spatulate lobe (See fig. 5) ..... **Lycaenidae**
5. With more than one pair of abdominal prolegs 6
   With abdominal prolegs absent except on 6th segment ..... **Geometridae, Hydriomenidae, Selidosemidae**
6. Two setae in prespiracular group of prothorax (See fig. 6) 7
   Three setae in prespiracular group of prothorax (See fig. 7) 8
7. Proleg-bearing segments with setae IV behind, and V below the spiracle; crochets in a longitudinal mesoseries (See figs. 8, 9) ..... **Noctuidae**
   Proleg-bearing segments with setae IV and V close together below the spiracle; crochets in a continuous ring or a penellipse (fig. 10) ..... **Pyralididae**
8. Setae IV and V of proleg-bearing segments close together below the spiracle (fig. 11) 9
   Setae IV and V of proleg-bearing segments distant from each other and below the spiracle (fig. 12) 16
9. Paired setae II of 9th abdominal segment on a sclerotized plate (fig. 13) 10
   Paired setae II of 9th abdominal segment not on a sclerotized plate (fig. 14) 12

* Adapted from keys devised by Hahn W. Capps of the Division of Insect Identification of the U. S. Bureau of Entomology and Plant Quarantine (E-475), May 1939.



Lepidopterous Larvae: Arrangement of Setae, Crochets, etc. (diagrammatic) [after Capps].

10. Seta I of 9th abdominal segment approximately equidistant from setae II and III (fig. 15).....**Tortricidae**
Seta I of 9th abdominal segment closely associated with seta III, on a single sclerotized plate (fig. 16).....11

11. Seta VI present on 9th abdominal segment (figs. 17, 18)..... **(Olethreutidae) Eucosmidae**
Seta VI absent from 9th abdominal segment (fig. 19).....**Phaloniidae**

12. Seta III of 8th abdominal segment directly in front of spiracle; seta I of 9th abdominal segment approximate to seta III but not on same plate (figs. 20, 21).....**Cosmopterygidae**
Seta III of 8th abdominal segment not directly in front of spiracle; seta I of 9th abdominal segment not closely associated with seta III (figs. 22, 23, 24, 25, 26).....13

13. Submentum with a large oval pit; seta III of 8th abdominal segment above and slightly behind the spiracle (figs. 27, 28)..... **Blastobasidae**
Submentum without an oval pit; or, if pit is present, seta III of 8th abdominal segment is above and in front of spiracle (fig. 29) 14

14. Setae I, II and III of 9th abdominal segment on a sclerotized plate (fig. 30).....**Hyponomeutidae** (part) **(Argyresthia)**
Setae I, II and III of 9th abdominal segment not on a sclerotized plate (figs. 31, 32).....15

15. Seta I closely associated with II on 9th abdominal segment (fig. 33).....**Oecophoridae** (part) **(Endrosis** and **Hofmannophila)**
Seta I of 9th abdominal segment not closely associated with seta II, approximately equidistant from setae II and III (fig. 34)..... **Gelechiidae**

16. Crochets of abdominal proleg in multiserial rings (fig. 35)..... **Tineidae** (part) **(Acrolophus)**
Crochets of abdominal proleg in a complete ring, enclosing a short longitudinal series, or in a pseudocircle (figs. 36, 37)..... **Hyponomeutidae** (part) **(Acrolepia** and **Plutella)**

DANAIDAE

Body with scattered minute short secondary setae; skin with numerous minute flattened granules; body banded segmentally with black, white and yellow rings; spiracles black, situated in the black rings. Caterpillars on milkweeds: *Asclepias, Gomphocarpus* and *Calotropis*. Monarch butterfly.....**Danaus plexippus** (Linn.)

NYMPHALIDAE

Two round white spots dorsally on abdominal segments 2-8; sparsely hairy. Caterpillar on *Gnaphalium*. Hunter's butterfly..... **Vanessa virginensis** Drury

Without the above dorsal white spots; more hairy, hairs white. Caterpillar on thistle, *Malva*, burdock and hollyhock. Thistle butterfly, or painted lady.....**Vanessa cardui** (Linn.)

PIERIDAE

Body light green, with a yellow middorsal stripe; proleg-bearing segments with yellowish or whitish pigmented longitudinal band, discontinuous shortly posterior to the spiracle; larger seta-bearing tubercles of abdominal segments higher than their width at base. Caterpillars on cabbages and related plants; also on *Nasturtium* and *Capparis sandwichiana*. Cabbage butterfly.....**Pieris rapae** (Linn.)

LYCAENIDAE

1. Body densely covered with short, fine setae.....2
   Setae of body fewer, larger, and of uneven size, some being longer. Feeds on lantana flowers.....**Thecla agra** Hewitson
2. Spiracles circular, black, conspicuous. Feeds mostly on lantana flowers, but has also been found on eggplant, berries of *Solanum nigrum* and fruit of *Cordia sebestena*.....**Thecla echion** (Linn.)
   Spiracles pale, inconspicuous. Feeds in flowers and pods of pigeon pea, *Crotalaria*, and several kinds of beans.....**Cosmolyce boetica** (Linn.)

SPHINGIDAE

Body yellowish, with large black segmental spots on dorsum tending to form transverse bands; usually a distinct middorsal longitudinal yellow line or stripe; prothoracic shield brownish yellow, with numerous white dots. Caterpillars feed especially on *Portulaca lutea*, also on *Boerhaavia diffusa*, *Fuchsia* and *Godetia*.....**Celerio lineata** (Fabr.)

Body green, which is sometimes obscured by fuscous markings or mottling; spiracles situated in circular dark spots; an oblique dark streak above each spiracle, slanting backward, and sometimes a conspicuous longitudinal dark streak connecting the oblique streaks on dorsum, and middorsal pale streak; prothoracic shield concolorous. Caterpillars feed on morning-glory and sweet potato vines.....**Herse cingulata** (Fabr.)

Body varying from yellowish green to dull greenish fuscous, sometimes pinkish; numerous pale specks in transverse lines on dorsum; spiracles oval, dark, surrounded by a narrow pale ring; above each abdominal spiracle a pale streak extending obliquely backwards; two vertical nearly parallel black streaks on front of head; prothoracic shield brownish or black; caudal horn black, curved. Caterpillars feed on tobacco, tomato, and more particularly on *Nicotiana glauca*.....**Protoparce quinquemaculata blackburni** (Butler)

AGROTIDAE

1. Prolegs absent on abdominal segments 3 and 4, present on segments 5 and 6.....2
   Prolegs present on abdominal segments 3 to 6.....3
2. A wide whitish longitudinal stripe on each side of the dorsal vessel and including setae I and II, or sometimes separated into three crinkly white lines; a conspicuous longitudinal white line just above spiracles and occupying nearly all of the space between

the spiracles and setae III. About 30 to 40 mm. in length. Feeds on nearly every kind of garden plant and weeds.....**Plusia chalcites** (Esper)

The dorsal longitudinal white lines not so conspicuous; the longitudinal white line above the spiracles occupying only one-third to one-half of the space between the spiracles and setae III. About 25 to 30 mm. in length. Feeds on cabbage and other cruciferous plants. It has been recorded on lettuce also. .....**Autographa brassicae** (Riley)

3. A yellowish middorsal spot on metathorax and on abdominal segments 1 to 4....Variegated cutworm, **Lycophotia margaritosa** (Haw.)
Without the above spots.....4

4. Skin with numerous short, sharp spines.....Corn earworm, **Heliothis armigera** (Hübn.)
Skin with numerous minute irregular-shaped sclerotized plates, or granulose.....Greasy cutworm, **Agrotis ypsilon** (Rott.)
Skin without the above structures.....5

5. Surface covered with numerous small white irregular spots and scrawly lines; usually longitudinally darker striped.....6
Surface without the above white spotting.....7

6. Color varying from green to nearly black; spiracles black, at the lower margin of a dark longitudinal stripe; a conspicuous white spot behind spiracle and a little higher; two dorsal longitudinal dark stripes separated by a narrower pale middorsal stripe....Nutgrass armyworm, **Laphygma exempta** (Walker)
Color varying from green to nearly black; spiracles pale with black rim, at the lower margin of a broad dark longitudinal stripe; a conspicuous small white spot behind spiracle and a little higher; dorsal area pale with a median darker narrow longitudinal stripe which is traversed by middorsal broken pale line.....Beet armyworm, **Laphygma exigua** (Hübn.)

7. Lobes of head pale testaceous with brown meshes; wide dorsal area pale with a mottling of light brown and some fuscous, and a middorsal longitudinal white line, the outer margins bordered with a white line; also white lines bordering the outer margins of the dorsal area; spiracles black, at the lower margin of a longitudinal fuscous stripe which is somewhat interrupted segmentally....Common armyworm, **Cirphis unipuncta** (Haw.)
Head dark brown in front, paler on vertex and laterally; body dark with a velvety appearance; two dorso-lateral darker spots on abdominal segments 6 and 7; spiracles black.....**Elydna nonagrica** (Walker)

PYRALIDIDAE

1. Seta IIb of mesothorax with a dark sclerotized ring at base.....2
Seta IIb of mesothorax without above ring.....4

2. Setae I and II of abdominal segments with strongly sclerotized and moderately large plates at base. Feeds in *Ceratonia* pods, also *Acacia farnesiana* and pigeon pea.....**Myelois ceratoniae** Zeller
Setae I and II of abdominal segments with definite small pigmented plates at base, not in white circles.....3
Setae I and II of abdominal segments with definite small pigmented plates at base and situated in white circles; upper surface

more or less fuscous. Feeds in corn silks, sorghum heads, and as a scavenger on cane leaves where there has been an infestation of aphis.....**Cryptoblabes aliena** Swezey

3. Seta IV of 8th abdominal segment separated from spiracle by about one diameter of spiracle; caterpillar smaller, about 13 mm. and about 1.5 mm. in width. Feeds in cereals and dried fruits, and in stored feed products.....**Ephestia cautella** (Walker)

Seta IV of 8th abdominal segment separated from spiracle by about 2 or 3 diameters of spiracle; caterpillar larger, about 16 mm. and 2 mm. in width. The Mediterranean flour moth. Often found in imported nuts.....**Ephestia sericaria** (Scott)

4. Meso- and metathorax each with a pair of sclerotized plates (without setae) on posterior dorsal margin. Feeds on seeds in lima bean pods, and some other beans also.....**Maruca testulalis** (Geyer)

Metathorax without the above plates; setae of abdominal segments situated in large brown sclerotized plates. Borer in sweet potato vines and tubers.....**Omphisa anastamosalis** (Guen.)

Meso- and metathorax without the above plates.....5

5. Ocellus I distinctly larger than ocellus II; head blackish or fuscous, with a distinct whitish area along adfrontal suture, extending to vertex. Body with pinkish longitudinal stripes. Feeds on cabbage and some other cruciferous plants....**Hellula undalis** (Fabr.)

Sclerotized plates at base of setae I and II of abdominal segments not pigmented, except a few of them on margins; prothoracic shield with two black marks laterally, the posterior one larger. Feeds on beet and amaranth leaves.....**Hymenia recurvalis** (Fabr.)

Sclerotized plates at base of setae I and II of abdominal segments not pigmented; head light brown; prothoracic shield testaceous, unmarked. In stored foods: cereals, nuts, dried fruit, etc.....**Plodia interpunctella** (Hübn.)

GELECHIIDAE

1. Abdominal prolegs rudimentary; each proleg usually with not more than 3 or 4 crochets.....Angoumois grain moth, **Sitotroga cerealella** (Oliv.)

Abdominal prolegs normal; each proleg with more than 3 or 4 crochets 2

2. Setae on prespiracular shield of prothorax triangularly arranged, shield not encircling the spiracle; crochets of anal legs uniordinal or biordinal, not interrupted at center; anal fork absent....3

Setae on prespiracular shield of prothorax in longitudinal line on the shield, which is elongate, the posterior end lying below and not connected with it.....5

3. Setae Adf_1 and Adf_2 of head close together, decidedly anterior to apex of front; P_1 but slightly above level of Adf_1 and with P_2 laterad of P_1.....4

Setae Adf_1 and Adf_2 not closely associated, anterior to apex of front; seta P_2 posterior to P_1; prothoracic shield light brown, with a pale reniform spot posterior to seta Ib; seta III of 8th abdominal segment above and in front of spiracle; crochets of abdominal prolegs uniordinal and arranged in a penellipse; skin smooth.....Pink bollworm, **Pectinophora gossypiella** (Saunders)

4. Prothoracic shield pale, whitish, with dark fuscous shading along lateral and posterior margins.....Tomato pinworm, **Keiferia lycopersicella** (Busck)

   Prothoracic shield entirely dark brown or blackish.....Potato tuber moth, **Gnorimoschema operculella** (Zeller)

5. Prothoracic shield yellowish brown; setae I and II of abdominal segments situated in a minute dark ring; seta III in a larger conspicuous dark ring situated just above spiracle; spiracle minute, pale with a dark rim. Caterpillar with a slight pinkish tinge when alive. About 15 mm. in length. In dead plant tissues: stems of castor oil plant, lantana, fibrous matter at base of palm leaves, stems of old capsules of *Ipomoea tuberosa*, etc. .....**Autosticha pelodes** (Meyrick)

   Prothoracic shield dark brown to fuscous. Whole caterpillar dark with velvety appearance when alive. Seta III just above spiracle, not in a conspicuous dark ring as above. About 16 mm. in length. In decaying leaves, etc., on ground beneath pigeon peas, beans, etc., also in the decaying leaves, etc., of turf.....**Stoeberhinus testaceus** Butler

PLUTELLIDAE

Plate at base of seta III enclosing abdominal spiracle; all setae situated in conspicuous black pigmented plates; crotchets in a complete circle. Larvae in onion leaves.....**Acrolepia assectella** (Zeller)

Plate at base of seta III not enclosing abdominal spiracle; setae not in conspicuous pigmented plates; abdominal prolegs long and slender, crotchets in a pseudocircle. Larvae on cabbages and other cruciferous plants.....**Plutella maculipennis** (Curtis)

COSMOPTERYGIDAE

Seta IIa of prothorax above level of seta Ia; crochets of abdominal proleg uniordinal, in a complete ring.....**Pyroderces** spp.

Body slightly pinkish on dorsum; head light brown; prothoracic shield dark brown; all body setae situated in pigmented sclerotized plates; seta III of 8th abdominal segment directly in front of spiracle; on other segments III is above spiracle; IV and V together in same sclerotized plate below spiracle; paired setae II of 9th abdominal segment on a transverse sclerotized plate. Caterpillars occur abundantly in the male inflorescence of *Pandanus*..... .....**Pyroderces incertulella** (Walker)

Body pink; head testaceous; prothoracic shield black; setae as above, except that the sclerotized plates are pale, and setae II of 9th segment are not together in the same plate. Caterpillars common in cotton bolls, corn silk and tassels, old pods of *Acacia farnesiana* and other legumes.....**Pyroderces rileyi** (Walsingham)

TORTRICIDAE

Prothoracic shield with black lateral margin. Leafroller on many kinds of garden plants and weeds.....**Amorbia emigratella** Busck

Prothoracic shield without black lateral margin. Leafroller on many kinds of garden plants and weeds.....**Archips postvittanus** (Walker)

EUCOSMIDAE (OLETHREUTIDAE)

(Skin minutely granulate; 10th abdominal segment distinctly and completely sclerotized in the following species.)

1. Body short, plump, pinkish tinged; sclerotized plate of 10th abdominal segment wider than long.....2

Body elongate, greenish tinged; setae in very small sclerotized plates; sclerotized plate of 10th abdominal segment longer than wide. Borer in stems and corms of nutgrass (*Cyperus rotundus*).....**Bactra truculenta** Meyrick

2. Head with wide black streak behind eyes; setae in pale sclerotized plates. Feeds in lantana flowers and bores in stem..... ..... **Crocidosema lantana** Busck

Head without black streak behind eyes; setae in conspicuous brown sclerotized plates. Feeds on seeds in pods of *Acacia koa* and *Acacia farnesiana,* also in *Sapindus, Dodonaea* and occasionally in beans.....**Argyroploce illepida** (Butler)

Heteroptera of Canton Island

BY ROBERT L. USINGER

University of California

(Presented at the meeting of November 8, 1943)

While visiting Honolulu in 1943 opportunity was afforded to study the undetermined Miridae of Canton Island. Other Heteroptera of Canton Island were listed by R. H. Van Zwaluwenburg (Proc. Haw. Ent. Soc. **11**: 306, 1943) as follows: *Geotomus pygmaeus* Dallas, *Nabis capsiformis* Germ. and *Halobates micans* Esch.

The Miridae were represented in the above list by a single damaged specimen of an "Undet. species" taken by Langford in April, 1940. This specimen proves to be the bean mirid, *Pycnoderes quadrimaculatus* Guerin, and quite possibly was brought to Canton Island from Hawaii in a collecting bottle, since no additional specimens have turned up in subsequent collections. Two specimens of

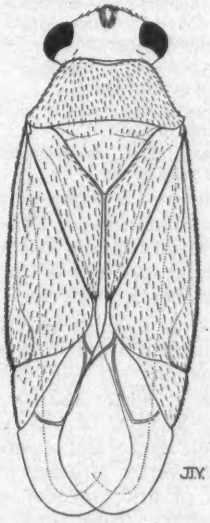


Fig. 1. **Cyrtorhinus zwaluwenburgi** Usinger. Holotype male (appendages omitted), Canton Is. (Drawn by J. T. Yamamoto).

the nearly cosmopolitan, grass inhabiting *Trigonotylus brevipes* Jakowlef were collected on Canton Island by R. H. Van Zwaluwenburg in August, 1940. Finally, three specimens of a new species of *Cyrtorhinus* are represented in the collection. This genus is widespread in the Pacific (Usinger, Proc. Haw. Ent. Soc., **10**:271, 1939), the various species being predaceous on eggs of Delphacidae. Since delphacids have not been reported from Canton Island and since both *Cyrtorhinus* and the cicadellid, *Nesaloha cantonis* Oman were collected on *Boerhaavia*, it is possible that this new mirid is a predator on *Nesaloha*. It is a pleasure to dedicate this new species to R. H. Van Zwaluwenburg, who has contributed so largely to our knowledge of the insect fauna of Canton Island.

Cyrtorhinus zwaluwenburgi Usinger, new species

Small, suboval, and entirely pale yellowish testaceous except for dark brown eyes and a vague brown area at middle of head. (Fig. 1.)

Head half again as broad as long, 11.5:8, smooth, shining, and strongly convex above. Eyes slightly less than half as wide as interocular space, 2.75:6. First antennal segment shorter than interocular space, 5: :6, second segment three times as long as first, third and fourth segments broken off. Rostrum reaching nearly to apices of middle coxae.

Pronotum somewhat duller than head, clothed with short, sparse, decumbent hairs; broader across humeri than width of head, 15: :11½, and less than half as long as broad, 6½: :15; front margin shallowly concave, lateral margins feebly sinuate, and hind margin slightly concave.

Scutellum longer than pronotum at middle, 7: :6, subdepressed, the disk very sparsely clothed with appressed hairs.

Hemelytra simple, distinctly but sparsely clothed with appressed hairs; costal margins slightly, evenly arcuate.

Legs slender, clothed with short, inconspicuous, pale hairs. Claws with simple hair-like setae rather than arolia.

Length, 2.35 mm., width across hemelytra .85 mm.

Holotype, male, Hawaiian Sugar Planters' Experiment Station, and one male paratype, Canton Island, November 20, 1940 (R. R. Danner). A teneral specimen is also at hand. It was swept from *Boerhaavia* on October 5, 1940, by R. R. Danner.

This species is very close to *riveti* Cheeseman in size and structure but is strikingly different from *riveti* and all other described *Cyrtorhinus* in color pattern. It will run to *riveti* in my key (*loc. cit.*) but *riveti* has a shorter second antennal segment (less than three times as long as first, 12::5), a longer rostrum which surpasses apices of middle coxae, and is entirely black with a white spot on either side of the vertex adjacent to the eyes, white at the extreme base and apex of first antennal segment, and pallid but faintly infuscated hemelytra. Like *riveti* and *mundulus, zwaluwenburgi* lacks distinct, convergent arolia which are characteristic of *lividipennis, fulvus,* and most of the great subfamily Orthotylinae.

BIOLOGICAL STUDIES IN HAWAIIAN WATER-LOVING INSECTS

PART III

DIPTERA OR FLIES
D. CULICIDAE, CHIRONOMIDAE AND CERATOPOGONIDAE

BY FRANCIS X. WILLIAMS
Experiment Station, H.S.P.A.

(Presented at the meeting December 13, 1943)

FAMILY CULICIDAE (The Mosquitoes)

It is probable that man has given more attention to the mosquito than to any other insect. The reason for this is obvious. Mosquitoes generally bite man, they are almost worldwide in distribution, and to that extent are a pest. They are frequently transmitters of disease and may be well adapted to man's habitat; there are day mosquitoes as well as those addicted to a night life. And while all mosquitoes require water for the development of their early stages, there are species suited to almost every type of water—pure fresh water, befouled fresh water, brackish water and water saltier even than the sea itself.

For all our knowledge of these noxious insects there still remains a very great deal to be learned about them. The life-history of many species, particularly in the tropics, is not known or but incompletely so, while it is a common belief that mosquitoes breed in tall grass or luxuriant herbage. Then again, the relatively much larger as well as quite harmless crane-flies (Tipulidae) often pass for mosquitoes of record size.

A typical mosquito has a slender piercing beak or proboscis, and the body, legs and wings are largely clothed with scales. The males have great plumose antennae—a character however, common to many other kinds of nematocerous flies. The hum of the mosquito is characteristic.

There are but three species of mosquitoes found in the Hawaiian Islands; two that are active in the daytime and one that is active at night; and while this is quite enough, our far-flung archipelago has fewer species of mosquitoes than many other Pacific islands; Samoa for example with 7 species, Fiji with 17 and Guam with 6.

Only the female mosquito bites, the male having mouth-parts not fitted for piercing the skin, feeds on nectar and plant juices. Not all species of mosquitoes are harmful; the genus *Megarhinus* for example, composed of large handsome species that as adults are plant feeders, are carnivorous in the larval stages, devouring the

young of other mosquitoes that live in tree holes, the butts of bamboos, rain barrels, etc. An attempt was made to establish a New Britain *Megarhinus* in the Hawaiian Islands, and although a considerable number of the mosquitoes were successfully introduced, conditions were not suitable for its maintenance at large; in the more tropical Fiji Islands however, a Javanese *Megarhinus* was introduced and successfully established. Mosquitoes of the genera *Psorophora* and *Mucidus* as larvae, devour the young of other mosquitoes but in the adult stage are vicious biters.

Much according to group, mosquitoes lay their eggs singly, in groups, or as "rafts". They are deposited on or near the water, and some kinds can endure prolonged draughts. The larva has four instars or stages of growth. It feeds by means of its mouth brushes that when in motion produce a current that brings small particles of food towards the mouth, or by nibbling algae, dead plant tissue, etc. with its well-formed mandibles. The posterior or respiratory end of the larva terminates in the siphon which connects with the tracheal or oxegenating system, and the anal gills the chief function of which is to absorb water (Wigglesworth, V. B.; The Function of the Anal Gills of the Mosquito Larva. Jour. Exper. Biol., **10**: 16-26, 1933). In *Anopheles* the anal siphon is so short as to be practically wanting, while in *Taeniorhynchus* it is sharply pointed for piercing the tissues of aquatic plants and from which oxygen is thus obtained. Mosquito larvae are adept swimmers, outstripping the larvae of any other aquatic flies known to me.

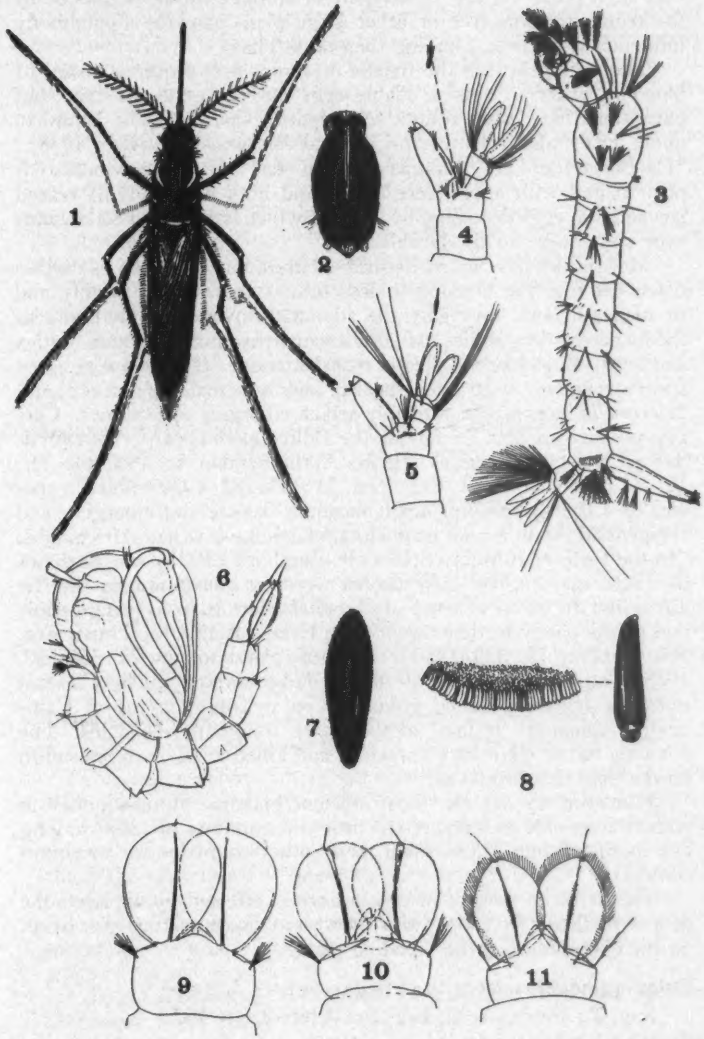
At the last moult the fourth instar larva is succeeded by the pupa. This humped and also active stage is likewise quite familiar to the casual observer. The pupa breathes by means of a pair of respiratory trumpets situated on the back of the thorax. It swims by vigorous strokes of the abdomen which terminates in a pair of broad paddles. When the time for the eclosion of the adult is at hand, the dorsum of the thoracic integument splits and the teneral adult works its way out, clings to the floating pupal shell for a while and finally takes wing.

As with other nematocerous flies the male mosquito has a

MOSQUITOES

EXPLANATION OF PLATE III

1. *Aedes aegypti*, female. Length 6.5 mm. Oahu.
2. *Aedes albopictus*, female, thorax, from above. Oahu.
3. *Culex quinquefasciatus*, larva, last stage. Length about 7 mm.
4. *Aedes aegypti*, larva, last stage, caudal end.
5. *Aedes albopictus*, larva, last stage, caudal end.
6. *Aedes albopictus*, pupa.
7. *Aedes albopictus*, egg. Bronzy black with fine white reticulations.
8. *Culex quinquefasciatus*, egg raft.
9. *Culex quinquefasciatus*, pupa, swimming paddles.
10. *Aedes aegypti*, pupa, swimming paddles.
11. *Aedes albopictus*, pupa, swimming paddles.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swarming habit. We sometimes see, or hear such swarms—of a very high pitch—in the darker part of an open room, or outside by the trunk of some tree or other large plant growth. Females fly into such swarms and mating then takes place.

The statement that the female mosquito first requires a meal of blood in order to deposit viable eggs may be generally true, but exceptions have been found. As regards *Culex pipiens* Linn., to quote Riley and Johannsen (Medical Entomology, : 216, 1938): "De Boissezon (1929) likewise found that this species would oviposit if fed with apple juice alone, and both he and Huff reared larvae from eggs deposited by females which had had no food whatever subsequent to the larval stage."

Mosquitoes have many natural enemies, but inasmuch as they so often get into the breeding places first, transform so rapidly and in such numbers, they gain the advantage over such predators as the larvae of dragonflies, of certain carnivorous flies, water beetles and bugs. Bugs like the slender marsh-treader (*Hydrometra*) often spear wrigglers with their beaks, and our little *Mesovelia* and *Microvelia* bugs would probably attack emerging mosquitoes. Certain predaceous flies, i.e. among the Dolichopodidae and Anthomyiidae are mosquito enemies. In the Anthomyiidae, for example, Dr. W. A. Lamborn (Bull. Ent. Res., **11**: 279-281, 1920) noted a species of *Lispa* fly preying upon mosquito larvae and emerging and crippled adults in a pool near Kotakota, Lake Nyassa, Africa, and: "In the Federated Malay States Dr. Lamborn (1921) saw a species of *Lispa* carrying on their useful work in such numbers that he attributed the entire absence of *Anopheles* larvae from certain pools and ponds partly to their agency". (Evans, A. M. E., Trans. Ent. Soc. London, **78**: 325, 1930). P. Tate (Parasitology, **27**: 556-560, 1935; Cambridge) found the larva of the anthomyiid fly *Phaonia mirabilis* Ringdahl to be predatory on mosquito larvae at Cambridge, England. It bred in the water found in tree holes. The *Phaonia* larvae were very voracious and killed many more mosquito larvae than they would eat.

However, by far the most efficient enemies of mosquitoes in waters accessible to fish, are the little top minnows or killifish, long ago imported into Hawaii and many other countries for mosquito control.

The artificial control of mosquitoes is effected by applying the proper methods, by cooperative effort and concentrating first of all on the elimination of the breeding places.

Culex quinquefasciatus Say. (plate figures 3, 8 and 9).

Say, T., Journ. Acad. Nat. Sci. Phil., **3**: 10, 1823.

(= *Culex fatigans* Wiedemann, 1828).

This is the common widely distributed night mosquito. It has been with us for well over a hundred years, having arrived here

presumably from San Blas, Mexico, in the ships' supply of water. It has a brownish thorax, the legs are nearly concolorous and the abdomen pale banded. It may occur wherever there is standing fresh water, and it has been seen in temporary ponds, puddles, pools befouled with decaying guava fruit and other organic matter. It breeds also in rain barrels, water troughs and other water containers. The eggs are deposited to the number of several hundred in the form of a raft that floats lightly upon the surface of the water. They hatch in a day or two, the wrigglers descending directly into the water from a rupture made in the thicker lower end of the egg shell. The larval or wriggler stage lasts from 10 to 14 days approximately, while the pupal stage is about 2 days, so that the entire life-cycle may not exceed two weeks.

The anal siphon of the larva of this *Culex* is much longer than in our two day mosquitoes.

Culex quinquefasciatus is sometimes wind-borne well into the mountains and elsewhere, and it is chiefly this species that may take shelter in our automobiles in garages.

Aedes aegypti (Linn.). (plate figures 1, 4 and 10).

Linnaeus, C., Hasselquists' Reise nach Palestina: 470, 1782. (*Culex*).

This is the yellow fever mosquito and also a carrier of dengue fever. It is less common here than *Aedes albopictus* and distinguished from it chiefly by the lyre-like markings on the dorsum of the thorax in contrast to the conspicuous median stripe of *albopictus*. The larva of *aegypti* has the "comb" on the siphon-bearing segment consisting of tridentate bristles, whereas in *albopictus* the bristles of the comb are simply sharp points arising from a wider basal portion (compare figs. 4 and 5).

Aedes albopictus (Skuse). (plate figures 2, 5, 6, 7 and 11).

Skuse, Indian Museum Notes, **3**: 20, 1895 (*Culex*).

This is the commoner of the two day mosquitoes and the less domiciliary one, as it very often breeds in our mountains, where I have seen its larvae and pupae in numbers in the rot hole in the bole of a large kukui tree (*Aleurites moluccana* [L.]). In and about the city its early stages may be passed in tree cavities containing water, in the water at the leaf bases of such plants as *Bilbergia, Crinum, Alocasia* and *Pandanus*, as well as in such water-containing receptacles as barrels, buckets and the saucers for flower pots.

Aedes albopictus is considered less effective in the transmission of dengue fever than is *Aedes aegypti*.

Aedes albopictus, commonly regarded as an Oriental species has sometimes been confused with the Australasian *Aedes scutellaris* (Walker) that occurs in the Pacific as far east as Fiji. For distinc-

tions between these two species see Edwards, Bull. Ent. Research, 7: 209-210, fig. 5, 1917; and l.c., 14: 370-371, 1924.

FAMILY CHIRONOMIDAE (The Non-biting Midges)

The members of this family range in size from minute flies to those equalling large mosquitoes. They are separable from the Ceratopogonidae, with which they were formerly associated, by a number of characters, among which are: wings lying rooflike over the back instead of flat over the back, as with the Ceratopogonidae, and the presence in the Chironomidae of a median groove in the metanotum. Finally, the Chironomidae usually are not as thickset as the Ceratopogonidae, and there are also distinguishing characters in the immature stages.

Fig. 1. *Chironomus hawaiicnsis*, male. About the size of a mosquito.

In his review of the Hawaiian diptera, with descriptions of new species (Proc. Hawaiian Ent. Soc., 8, 1934) on page 446, E. H. Bryan, Jr. records 7 species of Chironomidae. Further collecting by me, together with the discovery of 2 new species of *Telmatogeton* in the collection of the H.S.P.A. Experiment Station, has brought the total to at least 17 species. Inasmuch as 7 of these 10 additional species were taken on the Island of Oahu, it is very probable that many other species in this difficult group exist in our Territory.

I have derived much help in this work from the fine memoirs of the Cornell University Agricultural Station, on Aquatic Diptera, 1937—Mem. 205, part 3, by O. A. Johannsen; Mem. 210, part 4, by the same author, and part 5 (Ceratopogonidae) by Lillian C. Thomsen. Other indispensable works are those of F. W. Edwards

on the British biting midges (Ceratopogonidae) and the British non-biting midges, in the Trans. Ent. Soc. London, for 1926 and 1929, respectively, and J. R. Malloch's "Chironomidae or midges of Illinois"; Bull. Ill. State Lab. **10** (6), 1915. In addition, there are many more special papers that should be consulted.

Edwards (Trans. Ent. Soc. London **27**: 286, 1929) divides the Chironomidae into five subfamilies, of which three are represented in the Hawaiian Islands. These are the Chironominae, the Orthocladiinae and the Clunioninae, the last division including our marine species.

SUBFAMILY CHIRONOMINAE

Here belong the genera *Chironomus* and *Tanytarsus*, probably our most aquatic midges. Both are large genera in many other parts of the world, but in Hawaii only two species of *Chironomus* and one of *Tanytarsus* have been recognized. Both of these genera play a very important part in the economy of nature and are often the chief food of certain fish. As a rule, they are of little annoyance to man; their large swarms may rarely cause some inconvenience, while the bloodworm larvae of *Chironomus* sometimes breed in water tanks, whence they may be carried in tapwater to the wash bowl. *Tanytarsus* also, may gain entrance into similar tanks and other receptacles.

Chironomus hawaiiensis Grimshaw. (plate IV and text figures 1, 2 and 3).

Grimshaw, P. H., Fauna Hawaiiensis, 3 (1): Diptera: 4, 5, 1901, ♂ and ♀, Oahu, Waialua, Koolau range; Feb. 1893. pl. I, figs. 6 and 7.

Of this chiefly dull greenish brown, mosquito-size insect Dr. R. C. L. Perkins says (Fauna Hawaiiensis, **1**, Introduction): "*Chironomus Hawaiiensis* is one of the commonest of insects, especially near the coast or on the lowlands. Its status as a native insect is very doubtful. Being freely attracted to light, it often swarms in the verandah of houses, and forms a considerable part of the food of some of the lizards that haunt the same situation." It breeds—at first opportunity—in static or slowly flowing water, patronizing reservoirs, ponds ditches, overflows, taro and rice fields, untidy street gutters in wet districts, etc. In newly filled reservoirs, as yet unstocked with fish, it may occur in almost incredible numbers —first as elastic, nearly transparent jelly-like cylinders in which the eggs are imbedded and that wave gently at the water level from herbage, rocks or banks; then as freely-swimming, almost colorless young larvae; then as larger blood-red larvae undulating in or reaching from tubular retreats, or at large; and at last as active pupae. Under severe competition, so often its lot, *Chironomus* manages to exist among dense aquatic vegetation, such as blankets of algae.

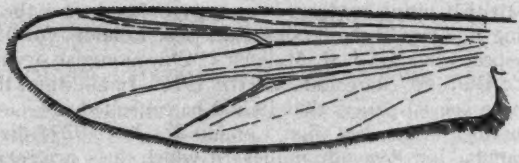

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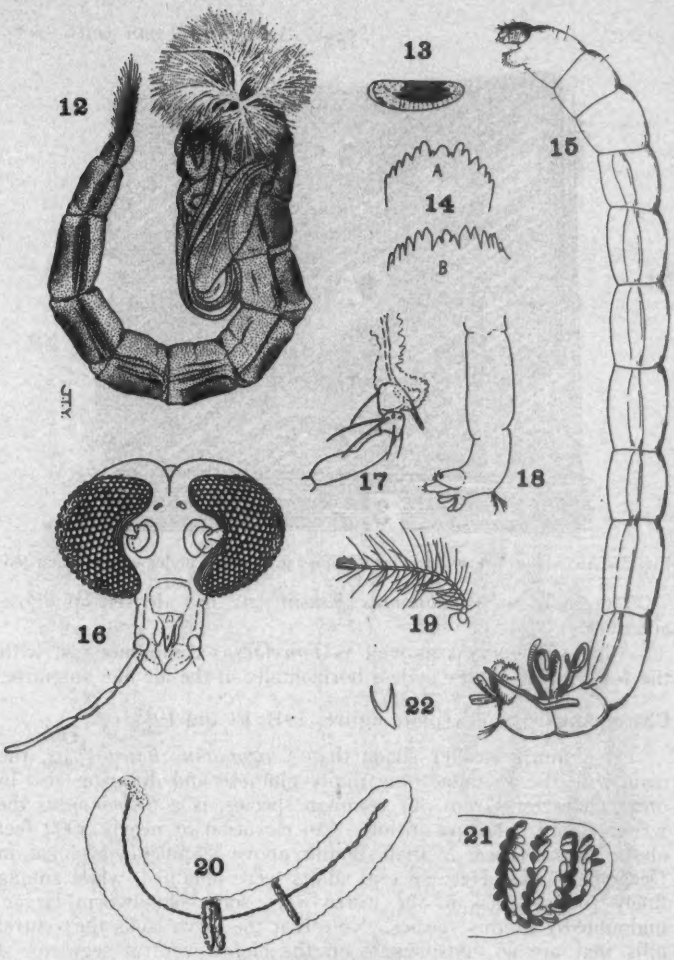
Fig. 2. *Chironomus hawaiiensis*, male wing.

The egg cylinder or rope of this species of *Chironomus* is from about 12 to 18 mm. or more long. In its periphery are imbedded many hundreds of eggs, each about 0.33 mm. long and arranged in alternating right and left loops. A pair of fine twisted fibres runs through the length of the cylinder, which is securely fastened to some object by a short stem. These slippery egg masses would not easily be grasped by fish or fowl.

The newly hatched *Chironomus* larva is nearly transparent and somewhat thicker at the thorax. There are two dark eye-like spots on the head. The anterior and posterior pairs of prolegs and the caudal gills and hair tuft are present. For some time the larva swims about freely in figure-8 fashion, but finally settles down to construct a tube of debris or whatever material is at hand, to serve as a shelter. As it grows and moults it assumes a reddish color due to the presence of free haemoglobin which assists in respiration by functioning as a carrier of oxygen. After probably the first moult, two pairs of elongate gills appear on the ventral surface of the eighth abdominal segment. Larvae may be found in numbers in their tubes that are fastened to the bottom or the sides of the pool, tank, etc. Here they may be seen reaching out from their tubes to grab flocculent mud, portions of algae, diatoms and other material as food or building material. Presumably to aid in respiration the larva frequently undulates rapidly in its tube. The pupa does this also but in less vigorous fashion. The pupa is provided with branching gill tufts of hoary white filaments that project from the prothorax, while at the depressed tail end are two rows of bristles that aid in locomotion. When the time for the eclosion of the adult nears, the pupa leaves its retreat and eventually by means of strenuous wriggling, reaches the surface; here it swims in aimless fashion and finally succeeds in breaking the surface film, an air-silvered portion of the thoracic dorsum then dryly protruding. Now the back of the thoracic integument splits apart, the adult insect almost pops out of this gap and, in a matter of a few seconds flies off with a mosquito-like hum. After an emergence of *Chironomus*, the widely-gaping pupal shells may be seen floating at the surface of the water.



CHIRONOMUS

EXPLANATION OF PLATE IV

12. *Chironomus hawaiiensis,* pupa.
13. *Chironomus hawaiiensis,* egg. Length 0.33 mm.
14. *Chironomus hawaiiensis:* A, mental plate; B, of *Chironomus* sp. from Wailau, Molokai.
15. *Chironomus hawaiiensis,* mature larva. Length about 13 mm.
16. *Chironomus hawaiiensis,* female, front view of head.
17. *Chironomus hawaiiensis,* adult, maxilla.
18. *Chironomus* sp. mature larva, caudal end. Wailau, Molokai.
19. *Chironomus* sp., male, antenna.
20. *Chironomus hawaiiensis,* egg string; only a few eggs shown. Length of string 14.5 mm.
21. *Chironomus hawaiiensis,* egg string portion, more enlarged.
22. *Chironomus hawaiiensis,* larva, posterior pseudopod hook.

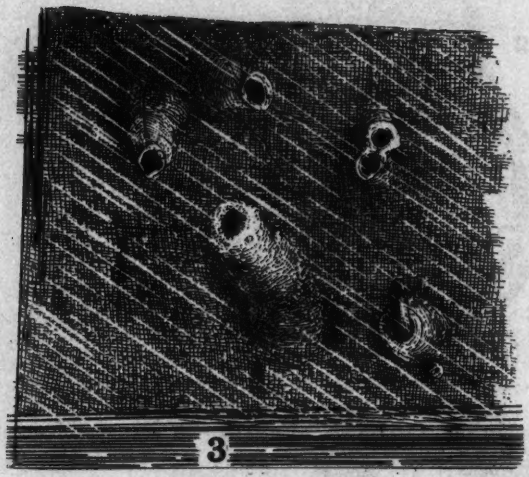


Fig. 3. *Chironomus hawaiiensis* larval tubes in the mud under water. Enlarged.

The male of *Chironomus hawaiiensis* has densely plumose antennae.

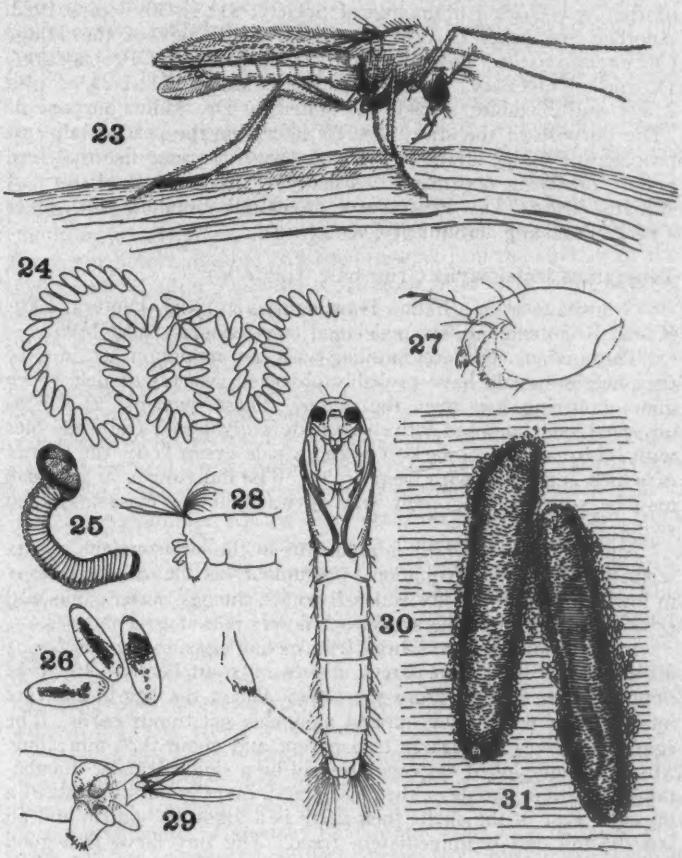
Adult *Chironomus* as well as *Tanytarsus* commonly rest with the forelegs held more or less horizontally in the air like antennae.

Chironomus species. (plate figures 14B, 18 and 19).

Of a much duskier shade than *Chironomus hawaiiensis,* the male with the antennae only thinly plumose and differing also in other characters from our common species, is a *Chironomus* the writer found in a tiny spring at an elevation of nearly 3000 feet above sea-level, near Wailau summit, above Mapulehu, Molokai, in December 1937. Here several adults were obtained, while among finely rooted grass in the water were some bloodworm larvae, undoubtedly of this species. Note that the larva lacks the ventral gills that are so conspicuous on the eighth ventral segment of *C. hawaiiensis* beyond the first stage.

Species of *Chironomus* have numerous enemies, such as dragonflies, water beetles, aquatic flies and bugs, and fish. *Hydrophorus pacificus* Van Duzee, a common Hawaiian dolichopodid fly pulls the bloodworms out of shallow water and greedily consumes them. Even *Cyclops,* a tiny crustacean destroyed newly hatched *Chironomus hawaiiensis* larvae. *Cyclops* would make a short dash at a larva, hold it for a moment, severely wounding it, or, more at length consumed a good portion of its prey.

Much has been written on *Chironomus.* An excellent paper on *Chironomus cristatus* Fabr. is by Miss Hazel Branch, in the Journal



TANYTARSUS

Explanation of Plate V

23. Female. Experiment Station, H.S.P.A., Honolulu. Length of body 1.5 mm.
24. String of 72 eggs. Diffused by placing in water.
25. String of eggs. As deposited.
26. Eggs, more enlarged. Length of egg 0.26 mm.
27. Larva, head, last stage. Length of larva 3.8 mm.
28. Larva, caudal end, from side.
29. Larva, caudal end, from beneath.
30. Pupa, ventral view. Length 2.9 mm.
31. Pupal cases. Length 5 mm. Experiment Station, H.S.P.A., Honolulu.

of the New York Entomological Society, **31**: 15-30, 3 pls., 1923. Another fine paper is Wm. O. Sadler's "Biology of the Midge *Chironomus tetans* Fabricius, and Methods for its Propagation" (Cornell University Agric. Exp. Sta.; Mem. **173**: 1-25, 2 pls., 2 figs. and 20 tables, 1934). As stated by Dr. Sadler on page 3: "The purpose of the study was to determine the practicability of propagating midge larvae as a forage crop for young fish that feed mainly on living organisms." Finally, "The Natural History of Aquatic Insects", by Professor L. C. Miall, London, 1895, gives a very interesting account of *Chironomus*.

Tanytarsus lacteiclavus Grimshaw. (plate V).

Grimshaw, P. H., Fauna Hawaiiensis, **3** (1): 5, Diptera, 1901. Kauai, Koholuamano, six males and two females, April 1895.

Those of us who are familiar with our mountain streams, be they ever so small, have probably observed swarms of pale green gnats hovering low over the water. These swarms, as far as observed, are composed entirely of male *Tanytarsus;* frail little flies with bushy antennae, dark eyes and a pale green body, the thorax of which is marked with deep brown. The individuals in a swarm may be seen working their way forward in the mass and then swinging to the rear.

And while *Tanytarsus* is abundant in the environment, as described, it is likewise common—presumably as the same species—in lowland reservoirs, lily and fish ponds, ditches, water tanks and even in water-containing saucers of flower pots in greenhouses.

In the laboratory, tank-bred females laid eggs, to the number of about 100, as little transparent masses or stout banners 10 or 12 minutes after issuing from the pupa. When the egg-masses are immersed in water they expand as feeble gelatinous cords. The eggs themselves are nearly transparent and about 0.26 mm. long. More than one lot of eggs may be laid by a single female. Incubation is less than two days, the glassy larva literally bursting out of a pressure rent in the shell; then there is a vigorous squirm and all but the tail end is immediately freed. The tiny larva is a good swimmer but soon settles down to construct a simple tube of debris that may be open at either end, attaching it to the substratum. Older larvae are largely greenish. The antennae are relatively long, there is a pair of prolegs at each extremity of the body and in addition posteriorly, finger-like gills and a double tuft of bristles. The pupa is pale glassy green. It may often be seen actively undulating within its debris chamber that is very thinly closed. When the time for hatching is at hand the pupa leaves its case, floats or swims to the surface and the adult issues without loss of time and flies away. This transformation was observed on numerous occasions in the grounds of the Experiment Station, Hawaiian Sugar Planters' Association, Honolulu, in the summer of 1939. Here several iron

drum tanks filled to a depth of 28 or 30 inches with water made to circulate very gently were used by a special research laboratory for studying the growth of sugar cane, a stalk of which was inserted in the water. Algal growth had developed on the sides and on some surface apparatus. Eventually *Tanytarsus* midges appeared, and I was glad of the opportunity to study the habits of these little green insects so conveniently situated. No swarming of *Tanytarsus* was ever observed here, for all seemed to be females. The larvae and pupae appeared at some depth in the drum. The flies emerged chiefly in the afternon, although no night watch was kept. Where a moment before nothing had been observed on the surface of the water, several adult *Tanytarsus* are now to be seen. However, by watching carefully one might discover a little silvered pupa rising up in a subvertical position from the sunlit depth. Progress is fairly rapid and occasionally hastened by brisk sculling; a spot breaks the surface of the water, head, thorax and appendages appear and, with a slight pull the end of the abdomen of the delicate green midge is freed from the gaping almost invisible pupal shell. A moment's rest and the midge takes wing. The entire transformation at the surface was a matter of from 17 seconds to a little more than a minute. All the *Tanytarsus* observed and reared from this iron drum tank were females, a number of which were captured immediately after emergence and found to lay viable eggs. From one such egg mass I reared a single adult, a female. This recalls an article by F. W. Edwards entitled: "Some Parthenogenetic Chironomidae". Ann. & Mag. Nat. Hist., (9) 3 (14) : 222-228, 1919). Here he shows that several species of Chironomidae, including *Tanytarsus boiemicus* Kieffer, are able to reproduce without the intervention of the male.

Tanytarsus is sorely beset by enemies. Damselflies and dragonflies plunge into their lazy swarms, while the larvae and pupae of these midges form an important element in the food of the nymphs of these Odonata. Hawaiian fresh water goby fish, or oopu, take their toll. And as these frail flies emerge from their pupal shells at the surface of the water, particularly among algae in a quiet pool, the little water-running bugs *Microvelia vagans* (White) pounce upon them to impale them on their beaks. Nevertheless, for all these handicaps, there are many places where *Tanytarsus* breeds unmolested and, thanks to its adaptability, maintains itself in abundance.

There are several species of marine *Tanytarsus* in the Pacific. Two of these occur in the Samoan Islands (Edwards, Insects of Samoa, **6,** Diptera, fasc. 2 : 62, 1928), while four others have been described from Japan (Tokunaga, "Chironomidae from Japan

(Diptera), II. Marine Tanytarsus", Philippine Jour. Sci., **51**: 337-368, 2 pls., 1933). The writer took a species of *Tanytarsus* flying about the seashore at Noumea, New Caledonia, in July 1940. It appears surprising that no marine *Tanytarsus* have been found in the Hawaiian Islands.

For an excellent article on *Tanytarsus dissimilis* Johannsen in Minnesota, see Cavanaugh, W. J. and Tilden, J. E.: "Algal food, feeding and case-building habits of the larva of the midge fly, *Tanytarsus dissimilis*", Ecology, **11**: 281-287, 3 pls., 1930.

SUBFAMILY ORTHOCLADIINAE

Here belong a few species of small size, the least known and perhaps the least aquatic group of our Chironomidae. The males may be seen in swarms in the moist mountains or in gardens—and particularly over fresh compost—in the city itself. This subfamily and the Clunioninae may be separated from the Chironominae in having the first joint of the fore tarsus shorter than the tibia, as well as by other characters. From the Clunioninae, which follows this subfamily, it is distinguished by the presence of a well defined horizontal pleural suture (anepisternal suture) and by the male antennae being usually plumose.

Grimshaw in Fauna Hawaiiensis, **3** (1): 5, Diptera, 1901, noted an unnamed species of *Orthocladius*.

Another undescribed species has been referred by Johannsen to the subgenus *Psectrocladius* (Bryan, E. H. Jr., Proc. Hawaiian Ent. Soc., **8** (3): 404. In **7** (2): 233, 1928 of the same journal, Dr. J. F. Illingworth reported that Dr. J. M. Aldrich had determined a tiny green midge which had been bred from water cultures, as *Metriocnemus* sp. (Chironomidae). The larvae of these flies constructed tubes on the walls of the dishes, reaching their heads out to feed and retracting when disturbed. "Two specimens had

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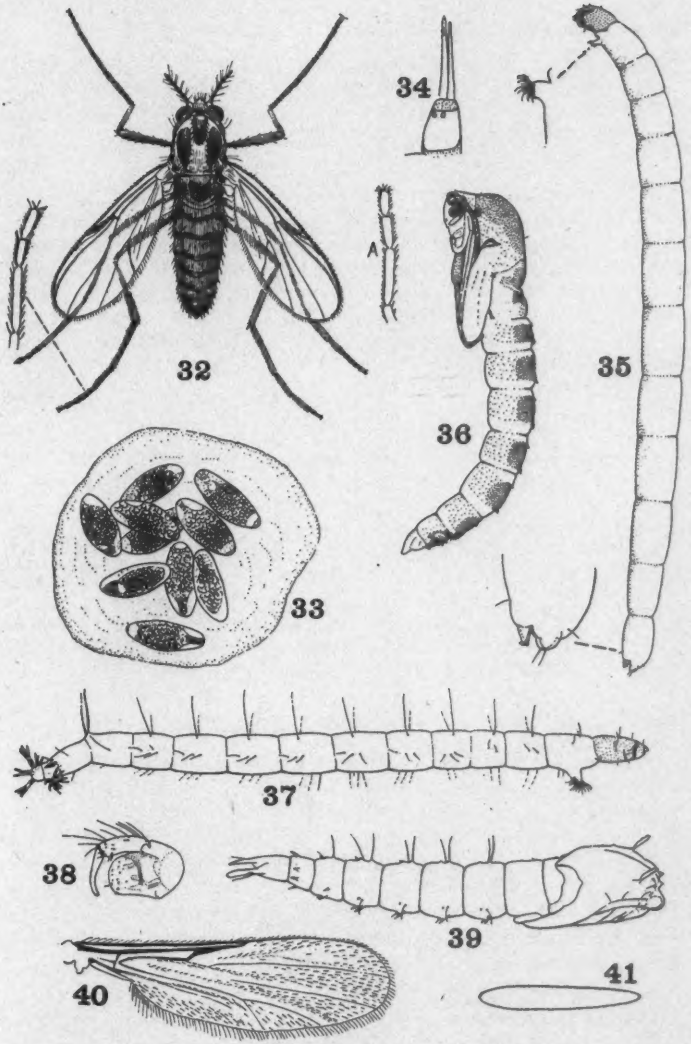
SPANIOTOMA and APELMA

Explanation of Plate VI

32. *Spaniotoma* sp. female, Mt. Kaala, Oahu, 3600 ft. elevation. Length 1.5 mm.; A, *Spaniotoma* sp., female, part of hind tarsus. Honolulu.
33. *Spaniotoma* of 32A, globule of eggs.
34. *Spaniotoma* of 32A, antenna of larva.
35. *Spaniotoma* sp., larva, Mt. Kaala, Oahu, 3600 ft. elevation.
36. *Spaniotoma* sp., pupa. Length 3.3 mm. Mt. Kaala, Oahu, 3600 ft.
37. *Apelma brevis*, larva, last stage. Length 3.7 mm.
38. *Apelma brevis*, male, part of terminalia.
39. *Apelma brevis*, pupa. Length 2.6 mm.
40. *Apelma brevis*, male, wing.
41. *Apelma brevis*, egg. Length 0.47 mm.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been previously bred from material collected in a lily pond by Mr. O. H. Swezey". This very much suggests *Tanytarsus*. I have made but a single specific identification in this subfamily.

Spaniotoma (Smittia) maculiventris Edwards.

Edwards, F. W., "Marquesan Insects—II", B. P. Bishop Museum, Bull. **114,** Pac. Ent. Surv., Publ. 7: 89, 1935. ♂. "Uahuka: Putatauua, Vaipaee Valley, altitude 880 feet, September 20, 1929, one male on dead banana leaves, Adamson."

"A species with extremely distinctive coloration."

I took numerous examples of this small midge in Honolulu, during January 1941 and 1943. The males were hovering in swarms over leaf compost, the females were perched nearby. This species, probably an immigrant, is prettily marked in yellow, rich brown and black; the male is more slender and has bushy antennae, the female is more heavily marked on the abdomen with black. The larva is probably terrestrial.

Spaniotoma No. 2 (plate figure 32).

Slightly larger than the preceding. The female is 1.5 mm. long, the male longer. The head and thorax are pale yellowish, the mesonotum having three dark and wide parallel stripes, the abdomen is grayish green, darker apically, and the legs grayish. This species is common about a spring at 3600 feet altitude, on Mt. Kaala, Waianae Mts., Oahu. Some of these flies were taken on foliage by this spring in 1938 and 1939, while a number were reared from masses of fine roots and diatomaceous material that were water soaked or sheeted over with water. The larva and pupa (figs. 35 and 36) taken from this locality may be this species.

Spaniotoma No. 3 (plate figures 32A, 33 and 34).

About 1.35 mm. long and with the median stripe extending the entire length of the mesonotum. A few females were taken, chiefly on windows in Honolulu. One of these laid 10 eggs as a glassy globule on the wet cotton stopper of a test tube. The eggs measured about 0.24 mm. long. A well-grown larva has a well developed anterior proleg; the posterior proleg is less developed and is sparsely provided with a few strong hooks. The larvae kept more or less submerged in some felt-like algae. They were unable to swim. The pupa much resembles that figured (36) from Mt. Kaala. It is provided with 3 bristles on each side near the eyes, while at the caudal end are 2 spines on each side of the gently bilobed median part, the outer spine the longer. The abdomen is finely roughened.

Spaniotoma No. 4.

One pale colored female specimen of what appears to be a *Spaniotoma* with some macrochetae along the wing veins. From Palikea, Waianae Mts., Oahu, 2,000 ft., November 15, 1936, on mossy ground.

Metriocnemus No. 1.

One male and 2 females of a hairy-winged midge that appear to belong to this genus. Mt. Olympus, Koolau Mts., Oahu, 2,100 ft. Reared February 2-9, 1939 from muddy moss.

The female is the more hairy winged.

Metriocnemus No. 2.

Six males from the spring at 3,600 ft., Mt. Kaala, Oahu, November 13, 1937 and December 26, 1938. On foliage.

A good account of the early stages of *Metriocnemus lundbecki* Johannsen in Illinois, is given by Dr. J. R. Malloch in Proc. Ent. Soc. Washington, **16**: 132-136, 1 pl., 1914.

SUBFAMILY CLUNIONINAE

In his key to the known genera of Clunioninae, Edwards ("Diptera of Patagonia and South Chile"; British Museum Publication, **2,** [fasc. 3]—Chironomidae: 31, 1931) places seven genera. Two of these—*Telmatogeton* and *Clunio* are represented in the Hawaiian Islands.

About 12 species of *Telmatogeton* have been recognized. The genus has representatives in South Africa and the Indian Ocean, South Australia, Japan, the Marquesas and the Hawaiian Islands and South Chile. With the exception of four Hawaiian species that inhabit mountain streams they are marine insects. A fifth species found along Hawaiian seashores was first taken in the Marquesas Islands to the south.

The habits of these insects are of great interest, and the Hawaiian species particularly need further study. They do not hover in swarms as do many other midges to the contrary; nevertheless the males especially, are very active insects and may often be seen racing about as if distraught—half running, half flying at the very margin of mountain torrents, rushing flume waters, or over wave-washed sea rocks. The eggs are laid singly or in groups where they are submerged or at least wet; the larvae construct more or less of a silken tube and seem incapable of swimming; the pupae are cylindrical with a large chitinous disk terminating the posterior extremity.

Telmatogeton pusillum Edwards.

Edwards, F. W. "Marquesan Insects—II", B. P. Bishop Mus., Bull. **114,** Pac. Ent. Surv. Publ. *7*: 88, 89, 1935. "Eiao: Vaituhu, October 2, 1929, 6 males, 3 females at light, Adamson."

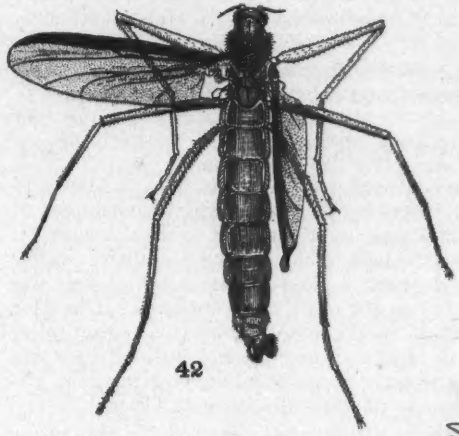
Specimens taken on a wave-drenched boulder at Waimanalo, Oahu, June 3, 1936, were identified by Mr. Edwards (at the British Museum) as this species. It is also found on the Waianae shore of Oahu. The adult fly measures from a little less to a little more than 2 mm. long and seems to be the smallest described species. The general color is brownish with the thoracic dorsum more or less gray pruinose and the wings a sort of dull smoky whitish, dark at the costa. It is long legged and ungainly. It is common at the upper tide belt where there is plenty of tufted oakum-like, pale yellowish green algae of the genus *Ectocarpus* (*Phaeophyaceae,* or brown algae). Here it may be seen racing in erratic fashion over the tide-washed rocks, and then taking wing. It appears able sometimes, to withstand the impact of the waves, for when one of these has receded the fly is immediately to be seen resuming its dodging course over the rocks. I have not observed it avoiding a wave by flight, as does to the contrary the little canacid fly of the sea rocks.

This fly was difficult to capture when active but could be bottled readily enough while at rest on coral ledges. When a stone bearing a quantity of *Ectocarpus* was immersed in fresh water, a number of *Telmatogeton pusillum* larvae appeared. These rather sluggish, non-swimming larvae had dark brown heads and olive green and brown bodies with sparse erect hair and anterior and posterior hook-bearing prolegs. At eclosion the pupa is extruded from its neat tubular retreat. The eggs were not observed.

TELMATOGETON

Explanation of Plate VII

42. *Telmatogeton torrenticola,* male. Length 5.5 mm. East Molokai.
43. *Telmatogeton torrenticola,* larva. Length 14.5 mm. East Molokai.
44. *Telmatogeton* sp., eggs. Waianae, Oahu.
45. *Telmatogeton* sp., pupa. Length 7.5 mm. Waianae, Oahu. Appendages loosened from proper position.
46. *Telmatogeton* sp., pupa, caudal end, viewed obliquely dorsad. Waianae, Oahu.
47. *Telmatogeton* sp., pupa, breathing horn and side of thoracic dorsum. Halemanu, Kauai.



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This fly is sometimes found in company with *Clunio* sp., a smaller marine dipter.

Telmatogeton abnormis (Terry).

Terry, F. W., Proc. Hawaiian Ent. Soc., **2**: 292, 295, plate 7, figures 6, 7, 8 and 9, 1913 (*Charadromyia* Terry). Habitat, Kilauea, Kauai.

This fresh-water species measures about 2.7 mm. in length of body. It has thus far been found only on the island of Kauai.

Telmatogeton sp. 1. (plate figures 44-46).

This insect has been confused with *T. torrenticola* of Maui and Hawaii, from which it differs by its smaller size, the character of the tarsal claws, etc. It is more nearly related to *T. abnormis*. It occurs both in the Koolau and the Waianae ranges of Oahu. While usually inhabiting well-forested regions it has in some cases followed swift-water ditches to the more open lowlands. It has for example, established itself in the hot semi-arid Waianae valley where it breeds along the algal margins of a cement-lined ditch that carries swiftly-running water. Here the adult fly often falls victim to the foraging fire ants (*Solenopsis geminata* [Fabr.]).

Dr. J. F. Illingworth, in a short paper entitled "Insects in the Waiahole Ditch" (Proc. Hawaiian Ent. Soc., **7**: 408-409, 1931) reported this insect as one of the chief constituents of masses of insects that piled up in a back eddy of this long open canal: The floating mass was composed largely of their pupae and cast larval skins. The adults were emerging in numbers." This *Telmatogeton* is common along rapid streams that have their origin behind Honolulu. In upper Manoa valley it is usually found at waterfalls, but I have seen an individual frantically racing about an area of less than a square foot on a steep wetted rock in a stream. It is often swept downstream but works its way up again. In its apparently aimless but swift progress at the water's edge it often collides with the dense groups of *Scatella* flies busy with courtship and feeding activities. Sometimes several male *Telmatogeton* in seeking to court the quieter female became involved in quite a tangle. The shining, dark-tipped eggs are found in clusters slightly under water or at its edge. Eggs kept in the laboratory hatched in about a week. The dusky olive larvae are non-swimming, provided with the usual prolegs and almost devoid of hair. They live in silk-lined tubes among algae that may be more or less exposed in the rapid marginal water; or they may be submerged an inch or two, where for example water curves swiftly over a rounded boulder. On one rock plane that was shallowly sheeted by rapid water their numerous silken-white galleries showed very conspicuously.

Telmatogeton torrenticola (Terry). (plate figures 42 and 43).

Terry, F. W., Proc. Hawaiian Ent. Soc., **2** (5) : 292-294, plate 7, figures 1-5 and 10-16, 1913 (*Charadromyia*). "Hab. Types ♂ and ♀ Nahiku, Maui (400-800 ft.) also Lahaina, Maui (1000 ft.); Kohala, Hawaii (1200-1500 ft.) Terry coll."

"In rapid streams and waterfalls". It appears to be this species that is found in the mountains of Molokai.

This is a duskier and much larger species than the two preceding, for it attains a length of body of about 5.3 mm. and a wing length of 5 mm. Besides occurring along mountain streams it is a common sight about rapid ditch water and along the often very swift water in the wooden flumes that traverse fields of sugarcane.

Terry (l.c.) has notes on the life history of this midge. The eggs are .3 mm. long and are deposited in single layers "often consisting of several thousands in a mass, evidently the product of several females". The larvae are at first greenish and later olivaceous and attain a length of 18-20 mm.

The fly probably has its share of enemies, but my only note on this subject refers to what seemed to be quite an ambitious *Lispocephala* fly (Anthomyiidae) attempting to overcome a *Telmatogeton* midge about as large as itself, at Akaka Falls, Hawaii.

Telmatogeton sp. 2 (plate figure 47).

This is our largest chironomid and apparently the largest species of the genus—in a series of ten specimens the body length ranges from 4.6 to 7.10 mm. while the wing length ranges from 6 to 7.7 mm. Apart from its superior size however, it is readily distinguished from the others by the relatively long and erect hair on the legs. It was taken on the Kauaikinana stream at Kokee, Kauai, September 6, 1919, by H. T. Osborn. The altitude here would be over 3000 ft.

Some of the marine *Telmatogeton* have received considerable study and the reader is referred to the following papers:

Hesse, A. J. 1934 "Contributions to a Knowledge of S. African Marine Clunione-Chironomids; (A) The Early Stages and Ecology of *Telmatogeton sancti-pauli* Schin. (= *Trissoclunio fuscipennis* Kieff.) from the Cape Coast." Trans. Royal Ent. Soc. London, **82**: 27-40, 4 text-figures.

Tukunaga, M. 1935. "Chironomidae from Japan (Diptera). **4**. The Early Stages of a Midge, Telmatogeton japonicus Tukunaga". Philippine Jour. Sci., **57**: 491-511, one text-figure, 3 pls.

Womersley, H. 1936. "An Interesting Chironomid *Telmatogeton australicus* sp. n. from a South Australian Reef." Records of the South Australian Mus., **5**: 439-443, 2 text-figures.

The genus *Clunio* (text-figures 4-6) consists of very small marine flies, the males between 1 and 2 mm. in length, with broad milky white wings, the females without wings. It is represented on the coasts of Europe, Japan, Samoa and the Hawaiian Islands, including Midway Island. These flies breed in the intertidal zone, but the European *Clunio marinus* Haliday may also be found in its immature stages among the algae to a depth of 15 meters (Goetghebuer, M. "Faune de France, 23, Dipteres Chironomidae", 4: 143, 1932). The larvae which are provided with anterior and posterior prolegs, construct shelters of silk interwoven with sand and debris.

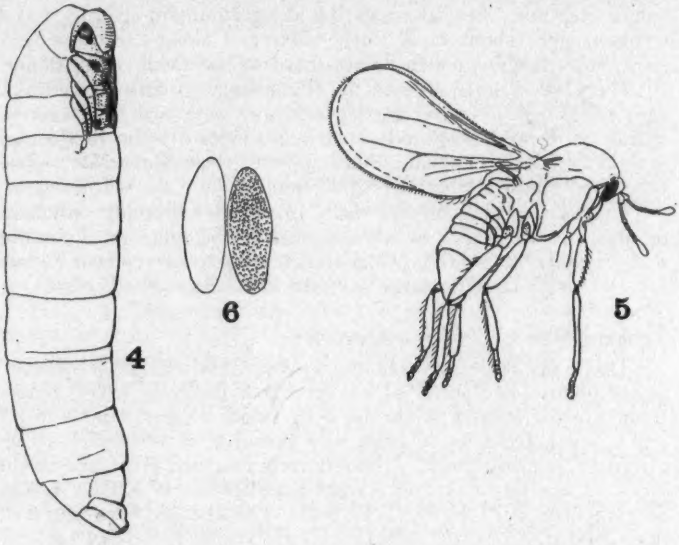

Fig. 4. *Clunio* sp., female pupa. Enlarged. Hanauma Bay, Oahu.
Fig. 5. *Clunio* sp., male. Enlarged. Midway atoll.
Fig. 6. *Clunio* sp., eggs. Length 0.24 mm.

The male *Clunio* are very active in their wild scampering progress low over the wet sea rocks, as they search for females exposed by the receding tide. One or more males would locate a female among the short green rock algae. Pairing was brief, the attached male buzzing its wings, the female remaining on the substratum. A few pairs were captured by means of a suction apparatus, or aspirator. A female that was confined in a vial laid a long gelatinous string of eggs, the latter being arranged at right angles to this string.

Males were often seen floating in little rock pools.

A series of *Clunio* taken at three points on Oahu: Hanauma Bay, Waimanalo and the Waianae coast were sent to the British Museum where Mr. F. W. Edwards determined them as three apparently undescribed species, each from its own locality. The writer also took male *Clunio* on the beach of Midway atoll, 1300 miles northwest of Honolulu, in the summer of 1941. But probably the earliest capture of *Clunio* in the Hawaiian Islands is represented by a male specimen taken by Mr. O. H. Swezey at Kaimuki, Honolulu, November 10, 1915.

Among the papers referring to marine Clunioninae are:

Edwards, F. W. 1926. "On Marine Chironomidae (Diptera); with Descriptions of a New Genus and Four New Species from Samoa"; Proc. Zool. Soc. London: 779-806; figs.

Buxton, P. A. 1926. "The Colonization of the Sea by Insects: with an Account of the Habits of *Pontomyia*, the only known Submarine Insect"; Proc. Zool. Soc. London: 806-814.

Saunders, L. G. 1928. "Some Marine Insects of the Pacific Coast of Canada"; Ann. Ent. Soc. America, **21**: 521-545; figs.

Tokunaga, M. 1933. "Chironomidae from Japan (Diptera) I. Clunioninae"; Philippine Jour. Science, **51**: 87-99; 2 pls.

FAMILY CERATOPOGONIDAE (The Biting Midges)

This is a large family of small flies, the females usually of stout form, the males more slender and with bushy antennae. Their larvae may be aquatic, subaquatic or terrestrial. The family is lucidly dealt with by Edwards ("On the British Biting Midges [Diptera, Ceratopogonidae]"; Trans. Ent. Soc. London, **74**: 389-426; pls. XCI-XCII and 3 text figs., 1926.).

While our few Ceratopogonidae appear to be of little economic importance, the family elsewhere contains many serious pests—i.e. those of the genera *Culicoides, Ceratopogon, Lasiohelea* and *Leptoconops*. These are often referred to as punkies, no-see-ums and sand flies. Several are disease carriers.

A number of species of Ceratopogonidae suck the blood of insects, attaching themselves to the wings or the body of their host. Among these hosts are dragonflies, butterflies, crane-flies (Tipulidae), mosquitoes and the caterpillars of butterflies and moths.

Among the papers referring to this subject, are:

Knab, F. 1914. "Ceratopogoninae sucking the blood of other insects"; Proc. Ent. Soc. Washington, **16**: 139-141 (hosts: *Anopheles, Culex* and Lepidoptera).

Macfie, J. W. S. 936. "Four Species of Ceratopogonidae (Diptera) from wings of insects"; Proc. Royal Ent. Soc. London, B. Taxonomy, **5**: 227-230 (hosts: Odonata and tipulid flies).

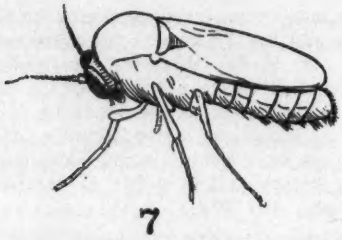

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Fig. 7. One of the Ceratopogonidae, female. Enlarged.

Macfie, J. W. S. 1937. "Notes on Ceratopogonidae"; ibid: 111-118 (hosts: Odonata and the larva of the noctuid moth *Laphygma exempta*).

Lever, R. J. 1940. "A Ceratopogonid fly attacking a caterpillar in Fiji"; Ent. Mo. Mag., (IV) **1**: 55; note by F. W. Edwards.

In the Island of Trinidad, B.W.I., a species of *Forcypomyia* is considered as most probably a cross-pollinator of the cacao tree (*Theobroma cacao* L.) (Billes, D. J., 1941. Tropical Agriculture, **18** (8): 149-156).

E. H. Bryan, Jr. in his "Review of Hawaiian Diptera, with Descriptions of New Species" (Proc. Hawaiian Ent. Soc., **8**: 405, 447, 1934), lists *Apelma brevis* Johannsen and three *Ceratopogon* species, of which one was determined by Dr. Johannsen as the subgenus *Prohelea*. The writer took four species of this family in the Hawaiian Islands, as follows: *Forcypomyia ingrami* Carter, *Apelma brevis* Johannsen, *Dasyhelea hawaiiensis* Macfie and *Dasyhelea calvescens* Macfie. Additional species should be found here.

Apelma brevis Johannsen. (plate figures 37-41).

Johannsen, O. A. "A New Midge injurious to Pineapples (Diptera, Ceratopogoninae)". Proc. Ent. Soc. Washington, **29**: 205, 207-208, 1927. Describes ♂ and ♀ and larva and pupa. *Apelma* is placed under *Forcypomyia* by Edwards.

This is a tiny brownish midge somewhat over a millimeter in length. It was observed by Dr. J. F. Illingworth as—"omnipresent in the water pockets in the axils of pineapple leaves—" (Proc. Hawaiian Ent. Soc., **7**: 206, 1929). Subsequently, Dr. Illingworth (ibid, **8**: 541-543, 2 figs., 1934) gives a brief account of its life-history and habits. He gives the incubation period of the dark cigar shape eggs as four days, the length of the larval stage from 28 to 45 days and the pupal stage four days.

The adults may be seen in small numbers flying in jerky zigzag fashion about pineapple plants (*Ananas sativus* Schultes, Bromeliaceae).

Most of my observations on this insect were made in November 1938, in a long abandoned planting of pineapples in the forehills of Punaluu valley, Oahu. Many young plants were examined. In addition to *Apelma*, larvae of the curious fly *Stenomicra orientalis* Malloch (Asteidae), of sidling gait, were observed breeding between the leaves.

The eggs of *Apelma* were found fastened for their length towards the tip of one of the innermost leaves and well above any axillary water. The pupa is active but cannot swim.

Forcypomyia ingrami Carter. (plate VIII).

Carter, H. F., Ann. Trop. Med. and Parasit., **12**: 290, 1919. Described from West Africa. Ingram and Macfie, Ann. Trop. Med. and Parasit., **18**: 584, 1924.

Occurs also in the Marquesas Islands, Samoa, Sumatra, Malaya, Trinidad, (B.W.I.) and doubtless elsewhere.

Forcypomyia ingrami is probably a widespread insect in the Hawaiian Islands. On the big island of Hawaii it has been taken at Kilauea, 4000 ft. (O. H. Swezey); and at Nauhi, 5200 ft. (O. H. Swezey and F. X. Williams); on Oahu it has been collected from the lowlands to the highest peak (4028 ft.). It may be very common in Honolulu during the wetter months—when more breeding places exist—the adults hovering in swarms before sunset about the gables of houses, the more prominent portions of the taller plant growth, or they may even use the gardener's head as a rallying point. Occasionally these swarms—which seem to consist almost entirely of males—become a nuisance. In December 1936—January 1937, following heavy rains, this midge invaded dwellings in certain parts of the city in annoying numbers. *Forcypomyia*, together with certain other small flies, is often attracted to freshly painted surfaces.

In the mountains one often observes their swarms dancing alongside trees and bushes.

When enclosed in vials stoppered with moist cotton or cloth, *Forcypomyia* often laid masses of glassy white eggs shaped like fat cigars, the mass swelling on being placed in water. The eggs are about 0.30 mm. long. In less than a week they hatch into glassy white caterpillar-like larvae with a large head bearing reddish eyespots and some dark shade at the mouth and within the head, both head and body being provided with club-like hairs and hairs of ordinary type. A large horn-like pair, the antennae, adorns the head in front of the eyes. Well forward on the breast is a large pseudopod by means of which the insect drags itself along. The mandibles play with alternate down and backwards strokes.

A number of well-grown *Forcypomyia* larvae were observed in the upper part of Hering Valley behind Honolulu, and living speci-

mens were brought to the laboratory for study. As this odd-looking creature rests with the lower part submerged, upon a wet leaf or bank, we note on its back the pairs of thickened, mostly club-shaped hairs arising from darkish cones, and often bearing a droplet of moisture while along the sides, curved hairs appear to support the insect in its upright position. It is very shiny and gleams somewhat reddishly beadlike in the light. The curious large head that is carried rather upright is somewhat elongate and tapers to the square-cut mouth, the two dark eyespots with a horn-like antenna before each; all help in the writer's mind to give the larva of *Forcypomyia* a decidedly bovine countenance. A note of June 13, 1933, on several well-grown larvae may be rendered as follows: "This morning beside the tiny stream in Hering Valley I watched several *Forcypomyia*. They were travelling slowly on a very wet leaf, their curved lateral hairs apparently resting on the thin sheet of water seeming to steady them. At the tail end and probably functioning as a blood gill is the extrusible delicate tapering process that is hair-fringed basally and extends upon the water. Here too is a terminal rosette, and some fine hooks that probably serve for anchorage when necessary. No tracheae were discerned. As the larva slowly advances, it moves its head from side to side with the mouth applied to the smooth surface of the leaf, the thin, shell-like mandibles probably scraping off fine material. A large larva was observed tilting its head forward and bring its mouth on a level with the surface film of water, when the mouth-parts, brush-like were seen moving with so great a speed as to draw a current towards them. As *Forcypomyia* slowly moves forward—and it seems unable to go backward—its progress is seen to be of a somewhat trembling or finely jerky character, due to the repeated strokes of the duplex proleg under the thorax. There is no humping up and forward, such as takes place in caterpillars, visible here. When a larva meets another, one of these will swerve swiftly aside; in fact if sufficiently disturbed, it may swing over far enough to reverse its position. I found that the most satisfactory way of capturing these tiny creatures was to drive them onto a bit of wet leaf which could then be

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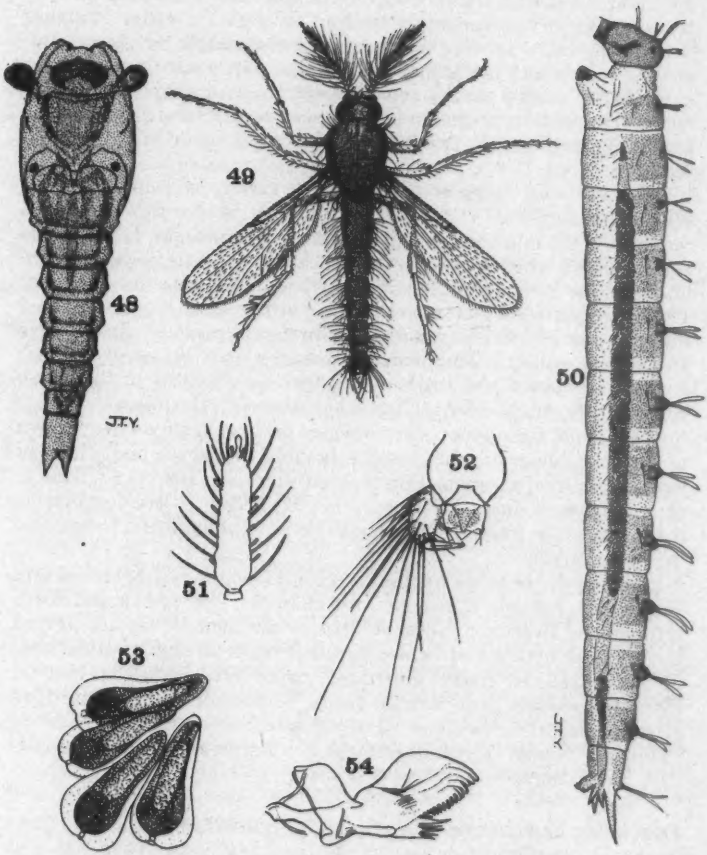
FORCYPOMYIA INGRAMI

Explanation of Plate VIII

48. Pupa, dorsal view.
49. Male.
50. Larva.
51. Male, last article of antenna.
52. Male, part of terminalia.
53. Egg cluster. Length of egg 0.45 mm.
54. Larval mandible.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lifted up. They float quite well, when they are able to make some progress by writhing very fast. Surface tension draws them quickly to nearby objects. They are helpless on a smooth surface under water.

In the laboratory the pale brownish pupae could be found, back up, upon a wet leaf, mass of algae, etc., the two, somewhat funnel-form respiratory trumpets protruding through the water film that covers the body itself. While apparently unable to swim, and indeed, open water is not their habitat, the pupae when turned over in the water so that the funnels are ventral and underwater, will by means of a jerk or a squirm or two, very neatly turn over on their back. The adult issues through a gaping crack made in the back of the pupa.

Forcypomyia ingrami breeds in a variety of situation. At Kilauea, Hawaii, in October 1929, Mr. O. H. Swezey secured a number of the adult flies from well-watered cabbages, between the leaf bases of which there was some detritus and decay and where no doubt the larvae were feeding. At Nauhi, Hawaii, in September 1931, *Forcypomyia* larvae were found at the base of the spathe of the calla lily (*Richardia aethiopica* Spreng., Araceae) where water and debris collect. The immature stages may be very common among wet leaves and trash in the forest as well as in the dense cover of the uluhi fern (*Gleichenia linearis* [Burmann] Clark).

The adult females of some species of *Forcypomyia* are known to suck the juices of other insects, notably the larvae and adults of lepidoptera, and to quote Edwards on *ingrami* (Insects of Samoa, pt. VI, Diptera, fasc. 2, Nematocera; 51, 1928): "In West Africa the larvae were found by Ingram to be semi-aquatic and to prey on mosquito larvae."

Among the enemies of this insect in Hawaii are dragonflies and damselflies, *Pantala flavescens,* for example, flying back and forth through the swarms of these midges, while their larvae are preyed upon by the nymphs of damselflies that occur in similar situations.

An excellent, finely illustrated paper on several species of *Forcypomyia* has been written by L. S. Saunders: "On the Life History and the Anatomy of the Early Stages of *Forcypomyia* (Diptera. Nemat. Ceratopogoninae)"; Parasitology, **16** (2) : 164-213, 26 textfigures and 3 plates, 1924.

Dasyhelea hawaiiensis Macfie. (plate figures 60-63).

Macfie, J. W. S., Stylops, **3** (6) : 133-134, 1 fig., 1934.

This tiny fly is about 1.25 mm. long and a sort of dark gray brown with the halteres conspicuously yellow. The male is more slender than the female and has plumose antennae.

The females may be seen in the daytime in low irregular zigzag flight, passing, or pausing over or alongside dripping wet banks that

are more or less clothed with such plants as dwarf ferns, moss, filamentous green algae, like *Cladophora*, and glistening, water-soaked masses of brown diatoms commonly of two kinds, the filaments of one made up, of waffle-shaped units, and those of the other, of deeply fluted sub-cylindrical ones. In addition, there would be fine intermingling soil, dead leaves and other organic matter.

Dasyhelea, difficult to follow because of her very small size, will alight upon a wet spot, walk a bit, perhaps fly off a few inches, hover, alight again, and for a while remain quiet. She was not observed in the act of oviposition, but her egg-masses are sometimes to be found attached to saturated algae alongside a thin waterfall, and captive flies often deposited eggs readily. The eggs, each enveloped in a clear elastic gelatinous substance, adhere to one another to the number of a few individuals to several dozen to form subglobular masses (fig. 62). At first pallid, they turn a sort of smoky brown; they are rather firm of shell and although really elongate, are doubled up short, as if mindful of their stubby parent on the one hand and of the slender larvae that are destined to hatch from them, on the other. The eggs measure from about 0.20 to 0.25 millimeter in their longer doubled-up diameter, the projecting portion being the head end. In due time two eye spots and a sort of throat, or pharyngeal skeleton may be seen through the eggshell and a day or so later the tiny larvae hatch out. They have a pale brown head, but the body is nearly transparent and lacks any pseudopod or false foot. The mandibles may be seen under the fore part of the head in alternate down and backwards movement suggesting grappling hooks. Throughout its life of several weeks in a water-soaked, or even quite immersed mass of algae, diatoms, etc., it is unable to swim but can travel swiftly snake-like a short distance among the plant filaments, and here even the mandibles may assist in locomotion, when it must pull itself along. There are a few erect hairs at and towards the tail end of the body, at the very extremity of which are four delicate tapering processes that are retractile and probably function as blood gills. A very delicate system of fine longitudinal tracheae is to be seen along the greater length of the body. Although no air was discernible within the larva, the latter went through motions—with its head to the surface—suggesting that it did drink in air.

When mature, the *Dasyhelea* larva is pale yellowish or orange brown and a little over 4 millimeters in length (fig. 60). As the time for transforming into a pupa approaches, the thorax becomes clearer than the rest of the body and swells considerably but with its three divisions marked off by strong incisions, while beneath the skin of the prothorax the two respiratory trumpets of the pupa

extending obliquely from back to breast, are clearly visible. During the act of pupation—which is quite rapid—these two long ear-like organs flip up simultaneously, being released as the old larval skin slips off the pupa. The light brown pupa, heavier than water and rather sluggish, is quite unable to swim, though twisting its abdomen in a tortuous manner. Like the larva, it frequently remains in fine water-soaked plant growth where it is able to work its way among the tangle of filaments and keep the back of the distal part of the breathing trumpets to the surface, anchoring itself firmly against any current by means of the two laterally-projecting horns at the extremity of the abdomen. When the time for the emergence of the adult is at hand, the pupal skin splits at the head and thorax above and the tiny fly crawls out, clings for a time to the anterior end of the now rather distended pupal shell and then flies off. The top of the thorax in such freshly issued flies, as noted in a female, is a rich brown color.

This insect has been found from nearly sea level to an altitude of over 2000 ft. Its larvae may be very numerous among algae thinly covered by flowing water, and I suspect that it is much preyed upon there by the nymphs of our large *Megalagrion oceanicum* damselfly.

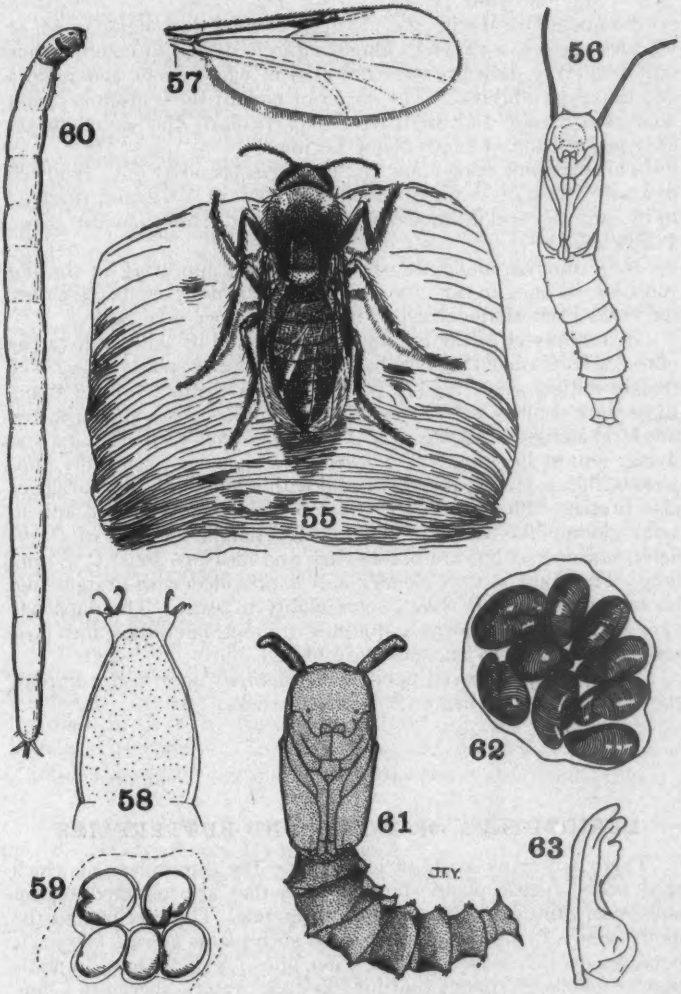
In addition to its dripping wet-bank habitat, this species also breeds in the leaf axils of *Dubautia laxa pseudoplantaginea* Skottsb. (family Compositae, tribe Senecionideae), a shrub that thrives in the cloud zone of our mountains. First observed on March 31, 1935 by Mr. O. H. Swezey (Proc. Hawaiian Ent. Soc., **9** (2) : 206, 1936), who refers to the insects found on this *Dubautia* "A few yellow mycetophillid (?) larvae were in moisture at the bases of the leaves", it has thus far been found in leaf axils far up the slopes of Mt. Olympus behind Honolulu. Both the larger larvae and the pupae are a sort of orange red. The pupal shells may be found on *Dubautia* leaves.

Further collecting will probably show that this insect is widely distributed over the higher parts of the Koolau Mountains.

DASYHELEA

Explanation of Plate IX

55. *Dasyhelea calvescens*, female. Length about 1.6 mm.
56. *Dasyhelea calvescens*, pupa.
57. *Dasyhelea calvescens*, male wing.
58. *Dasyhelea calvescens*, larva, caudal end; not all the hooks are shown.
59. *Dasyhelea calvescens*, egg cluster. Egg about 0.18 mm. long.
60. *Dasyhelea hawaiiensis*, larva, last stage. Length 4.05 mm.
61. *Dasyhelea hawaiiensis*, pupa.
62. *Dasyhelea hawaiiensis*, egg cluster. Length of egg 0.21 mm.
63. *Dasyhelea hawaiiensis*, larval mandible.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Dasyhelea calvescens Macfie. (plate figures 55-59).

Macfie, J. W. S., Proc. Zool. Soc. London, series B, taxonomy, 7: 157, 158, 1938. Described from Hanauma Bay, Oahu, May and June 1936.

To quote Dr. Macfie (l.c.: 157): "A small very dark brown or blackish species, with wings almost entirely devoid of macrotrichia, scutellum very dark brown, halteres with white knobs and femora and tibiae dark brown." The posterior part of the scutum is rather depressed mesad, and this part and particularly the scutellum are of a paler shade. Length about 1.6 mm.

This maritime midge may be the species found by J. C. Bridwell in a salt marsh at Waikiki, Honolulu, May 30, 1919, and referred to by him as a species of *Ceratopogon* (Proc. Hawaiian Ent. Soc., 4: 284, 1920).

It is common along the shores of Oahu appearing in the hot sunshine, buzzing in tiny, more or less zigzag movements close over the rocks back of the beach or nearer the upper tidal zone.

It is an insect of the highest tidal zone and of salt water canals (the Ala Wai canal). It also breeds in the upper splash pools. The female midge when freshly hatched has a distinct orange tinge. Eggs were secured in December 1939 from flies taken about the low tide level along the Ala Wai canal. Here *Dasyhelea* was running and flying, almost hugging the exposed area that was plentifully supplied with fine low algal growth, and with white tooth-like barnacles also present. The eggs, each enveloped in clear jelly, are laid in small globule-like batches. They much resemble the eggs of *Dasyhelea hawaiiensis* but are not so dark and measure about 0.18 mm. long. The larva is very slender and is provided with grapple-like hooks posteriorly. It shows some ability to swim. The pupa has very long breathing horns and a pair of stout, laterally spines posteriorly. Both larva and pupa are orange.

This midge is preyed upon by *Cymatopus acrosticalis* Parent, the dolichopodid fly that patrols the sea rocks.

PART IV

LEPIDOPTERA OR MOTHS AND BUTTERFLIES

There are many kinds of lepidoptera, the caterpillars of which feed upon aquatic plants, but the ones that are modified for an aquatic or subaquatic life are relatively few. These belong to the moth family Pyralidae, and live upon such plants as rice (*Oryza*), pond weed (*Potamogeton*) and water lilies (*Nymphaea*). In addition to the above species that inhabit quiet waters, there are a few others that are found, both as larvae and pupae, wholly submerged in swiftly running water. Here the larvae live beneath sheets of

spun silk and feed on algae. (Lloyd, J. T., "Lepidopterous Larvae from Rapid Streams"; Journ. New York Ent. Soc., 22: 145-152, 2 pls., 1914. *Elophila fulicalis* Clemens, in New York State). Another interesting species of much the same habits is *Aulacodes simplicialis* Snell that was observed by Messrs. F. Muir and J. C. Kershaw in 1908, in a mountain stream in Lappa, "a mountainous island on the western side of the harbour of Macao", China. The larvae lived sometimes at a depth of 18-24 inches under swiftly flowing water. The cocoon is so constructed as to allow the passage of water through it and at the same time keep the pupa dry. And to quote, on p. xliv: "The adult moth readily takes to water when frightened, diving below the surface and using the legs for swimming—" (Notes on the Life-History of Aulacodes simplicialis Snell"; Proc. Ent. Soc. London, 1909: xl—xliv, 4 figs. Transmitted by Prof. E. B. Poulton).

The flightless form of the female of the European *Acentropus niveus* Ol., the larva of which lives on *Potamogeton*, passes its life in the water. It swims, by means of its modified posterior legs, near the surface of the water where it mates with the male, then sinks, lays her eggs on the submerged plant and dies. (See Karny, H. H. "Biologie der Wasserinsecten": 159-160, fig. 102, 1934 [aus Lampert]).

The genus *Nymphula* (= *Hydrocampa*) is widely distributed and contains numerous species, a few of which are rice pests. Their larvae are often provided with fine filamentous gills along the body, and to facilitate respiration under water such larvae are described as performing regular undulatory movements—as do *Chironomus* fly larvae.

Further literature on this group of moths is as follows:

Reamur, R. A. F. de. "Memoires pour Servir a L'Historie des Insectes, Tome 2, Dixieme Memoire. Des Chenilles Aquatiques": 391-406, pl. 32, 1736. A species of *Potamogeton*.

Miall, L. C. "The Natural History of Aquatic Insects", 1895. Aquatic Caterpillars: 226-235, 1 fig. *Hydrocampa nympheata* (Linn.), *Cataclysta lemnata* (Linn.), *Paraponyx stratiotata* (Linn.), etc.

Hampson, G. E. "Fauna British India", Moths, **4**, 1896. On pp. 187-241, subfamily Hydrocampinae.

Hart, C. A. "On the Entomology of the Illinois River and Adjacent Waters", Bull. Ill. State Lab. Nat. Hist. 4(6), 1896, Lepidoptera on pp. 164-183 and 278, pls. 1 and 2. *Paraponyx obscuralis* Gr., *Hydrocampa obliteralis* Walk., etc.

Maxwell-Lefroy, H. and Howlett, F. M. "Indian Insect Life", 1909. *Nymphula depunctalis* Guen., p. 515-516; colored plate.

Needham, J. G. and Lloyd, J. T. "The Life of Inland Waters", 1916: 218-220.

Sison, P. "Observations on the Life History, Habits and Control of the Rice Caseworm, *Nymphula depunctalis* Guen." Philippine Jour. Agric., **9**: 273-301, 4 pls., 1938. Also feeds on *Panicum* sp., *Paspalum* and *Eragrostis*. Life cycle, 21-37 days.

Nymphula fluctuosalis Zeller. (plate X).

Zeller, K. Vet.-Ak. Handl.: 27, 1852.

"*Hab.* Throughout the tropical and subtropical zones, on the north to Formosa and Sandwich Islands, on the south to Australia". (Hampson, "Faun. Br. India" Moths, **4**: 194, fig., 1896).

This moth occurs on the larger islands of the Hawaiian group. The earliest record of its presence here seems to be that given by Butler in May 1879 under the title: "On Heterocerous Lepidoptera collected in the Hawaiian Islands by the Rev. T. Blackburn", (Ent. Mo. Mag., **15**: 270, 1878-9), the moth being under the name of "*Oligostigma curta*, n. sp." Following its description, Butler quotes Blackburn thus: "Not uncommon about grassy streams in mountain valleys, when such can be found, and that is seldom". It is a delicate whitish moth with fulvous bands on wings and abdomen. The wing expanse is from 16 to 21 mm.

The caterpillar is a case-bearer, and when rice was extensively grown here was somewhat of a pest on that crop. It also feeds on other grasses, and Mr. O. H. Swezey once found it damaging the leaves of water lilies (*Nymphaea*) in Nuuanu valley, Honolulu, in September 1932. The moth is often taken at light. It lays a number of flattish, rather elliptical yellowish eggs a little more than half a millimeter long. The young larva has a pair of long hairs on the dorsum of the terminal segment and there are also some sparse shorter hairs. Later on it acquires dorsally and laterally on the body, fine filamentous gills enclosing air tubes that join the longitudinal tracheal trunks. The pupa is formed within a case or cocoon and is not extruded at the eclosion of the adult. The larva is subaquatic.

NYMPHULA FLUCTUOSALIS
Explanation of Plate X

64. Larva, last instar.
65. Adult female. Expanse 17 mm.
66. Group of eggs.
67. A single dorso-lateral larval gill.
68. Pupa, caudal extremity, side view. Drawn from a dried specimen.

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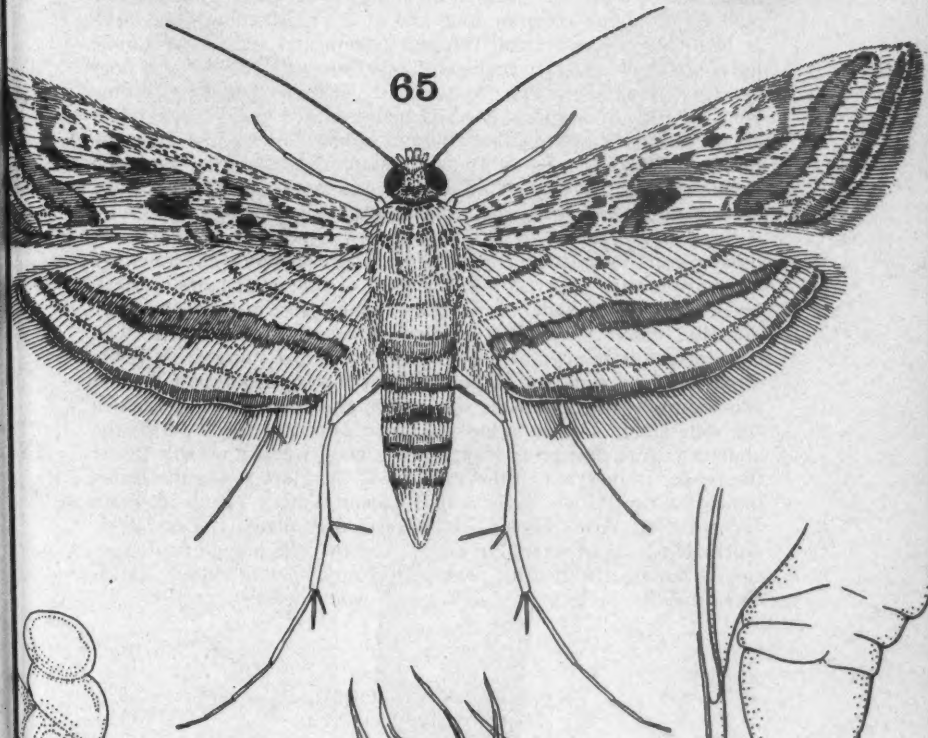

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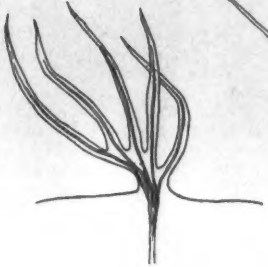

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Nymphula obliteralis (Walker). (plate XI).

Walker, Cat. Brit. Mus., **17**: 399. Described from Florida and Texas; rather widely distributed in the United States.

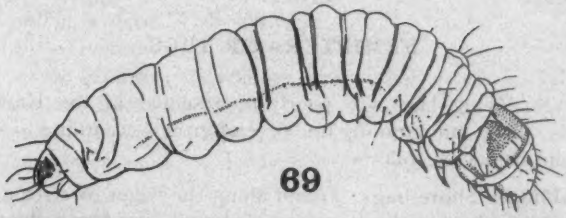
A duskier and heavier moth than *N. fluctuosalis*. It is a recent and unwelcome immigrant in the Hawaiian Islands, having been first reported by Mr. D. T. Fullaway who reared it from water lilies (*Nymphaea*) in Honolulu early in 1942. Later in the year it was reared by O. H. Swezey and by F. X. Williams. (Proc. Hawaiian Ent. Soc., **11**: 277, 1943).

A group of eggs of this moth were found securely glued to the underside of a lily leaf close to the margin (fig. 71). They are low oval domes about 0.65 mm. long and of a whitish color. The larva at birth has a longitudinal tracheal system and some long simple hairs but does not later acquire filamentous gills (fig. 69). It does extensive though sporadic damage to lily leaves so that these become very ragged. It forms a case of pieces of the leaf and wanders about as a case-bearer, inflicting its unsightly damage also upon the flowers of the lily, and well merits the name "miserable sandwich worm" given it by my wife, copartner of a small lily pond. The larva also uses the leaves of other aquatic plants for making cases. A large larva 9 mm. long has a pale brown head, a darker narrowly fissate prothoracic shield and a dull pallid green body. The antennae are conspicuously porrect and there are sparse erect hairs on head and body. When under water the extruded fore part of the body dorsally, from the second segment, is beautifully silvered. The cocoon case is blunter at the fore end, and in issuing from it the moth makes a wide slit in the silk. In the laboratory the cocoon was securely fastened to the side of the glass container, just above the water line. The pupa has the spiracles on segments 2-4 of the abdomen large and protruding. For a good treatise on this insect the reader is referred to the work of C. A. Hart ("On the Entomology of the Illinois River and Adjacent Waters", Bull. Ill. State Lab. of Nat. Hist., **4**(6): 174-180, and 278, plate II, Dec. 1895-April 1896). Hart writes, p. 176: "The favorite home of this species is among the floating leaves of *Potamogeton nutans*, which often thickly cover the surface of quiet water in large patches."

NYMPHULA OBLITERALIS

Explanation of Plate XI

69. Larva, last instar.
70. Adult, a small, rather dark specimen. Expanse 11.5 mm.
71. Eggs on underside near margin, of *Nymphaea* leaf. Length of egg 0.65 mm.
72. Larva in case made of bits of *Nymphaea* leaf.
73. Pupa. Length 5.2 mm. Two views of second visible spiracle.



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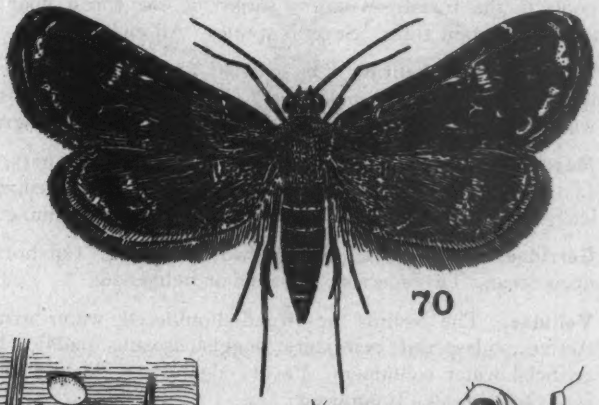

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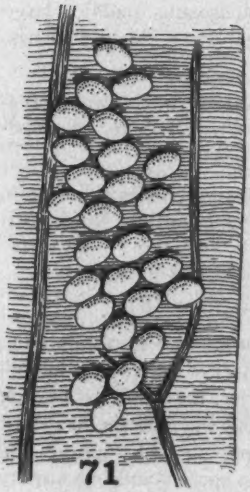

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PART V

HEMIPTERA OR BUGS

Water-loving bugs are poorly represented in the Hawaiian Islands. They fall naturally into several groups according to structure and habits, as follows:

1. **Saldidae.** Shore-bugs. Found along the edges of streams and pools in the forest, on mossy banks, on the forest floor and along mountain trails. Several species. All endemic.
2. **Hebridae.** The hebrids. On mats of algae in reservoirs, on the edges of stagnant pools, etc. Chiefly in the lowlands. A water-running bug, often submerging. One species. Immigrant?
3. **Mesoveliidae.** The mesoveliids. Active water-runners, but favoring algal mats, leaves of water plants and the edges of sluggish streams. Chiefly lowlands. One species. Immigrant.
4. **Gerridae.** In our case, pelagic water-striders. Offshore or open ocean. Two species. Endemic or indigenous.
5. **Veliidae.** The veliids or broad-shouldered water-striders. Active; widespread; reservoirs, sluggish streams, puddles, large artificial water containers. Favors algal mats, floating debris, etc. One species. Immigrant?
6. **Notonectidae.** The back-swimmers. Living in the water, reservoirs, ponds, pools in the forest, water troughs, etc. One species. Presumably immigrant.
7. **Corixidae.** The water-boatmen. Inhabiting chiefly the bottom of pools, in our case, preferably saline. One species. Not known elsewhere.

FAMILY SALDIDAE (text figure 8)

Our *Saldula* are broad little bugs from about 3 to 6 mm. long, brownish to black but with the hemelytra marked with pale window-like spots and dashes. The wings—under the hemelytra—may range from mere stubby rudiments to nearly or quite the length of the hemelytra. They are very active, hopping and running and some are able to fly a short distance. Five species and one variety are listed by Kirkaldy (Fauna Hawaiiensis, 3 (*2*) : 146, 1908, and

t.c., pt. ibid **2** (6) : 554, supplement to Hemiptera, 1910) under the genus *Acanthia,* as follows:

Acanthia exulans (F. B. White).
Acanthia oahuense (Blackburn).
Acanthia oahuense (Blackburn), var. *molokaiensis* Kirkaldy.
Acanthia humifera Kirkaldy.
Acanthia nubigena Kirkaldy.
Acanthia procellaris Kirkaldy.

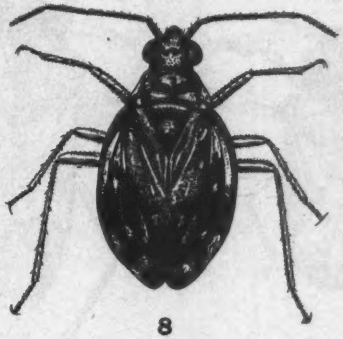

Fig. 8. *Saldula* sp., Hering valley, Honolulu. Enlarged.

This group however, is recognized as being badly in need of revision. In addition to the environment already mentioned, Dr. R. C. L. Perkins has upon occasion found *Saldula* to be to some extent arboreal (Fauna Hawaiiensis, **1** (6), Introduction: cciii, 1913). Practically nothing has been published as yet on the developmental stages of our species. Dr. R. L. Usinger has succeeded in rearing an Oahuan *Saldula* from egg to adult (Proc. Hawaiian Ent. Soc., **9**: 359, 1937).

Although *Saldula* can easily maintain itself upon the surface of the water, it seems unwilling to do so and quickly makes for shore. It is carnivorous in its habits, and I have seen it in Manoa valley probing algal covered boulders for the larvae of Tipulidae or crane-flies.

FAMILY HEBRIDAE

Merragata hebroides White. (text figure 9).

White, F. B., Ann. and Mag. Nat. Hist. (IV) **20**: 114, 1877. "On small stagnant pools formed by the temporary overflow of

streams on the higher mountains. When the pools dry up, the insect frequents the holes where the water has been."

This is a compact little bug about 2 mm. long. It is rather leisurely, even tedious in its movements, and its short water-skimming flights do not suggest much energy. *Merragata* is a common

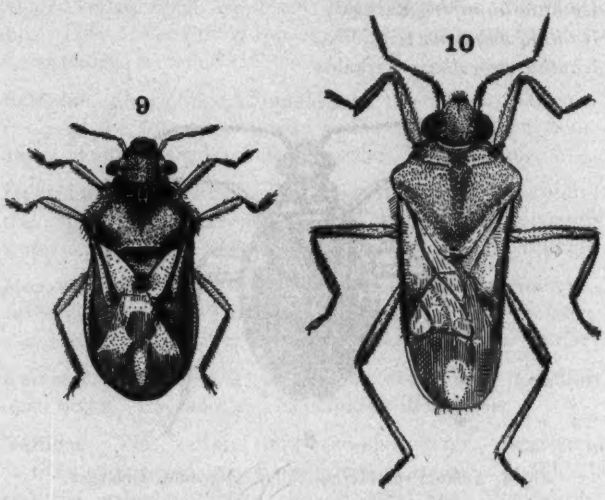

Fig. 9. *Merragata hebroides.* Length 2.20 mm.
Fig. 10. *Microvelia vagans,* alate form.

insect at puddles, along stagnant portions of streams and in reservoirs, occurring there on algae and algal blankets. Both young and mature bugs readily pull themselves under water, where they become conspicuous because of their air-silvered bodies. They may remain submerged for some time. In the laboratory one was seen sucking the juices of an immature one of its own kind that still showed signs of life. And here it was preyed upon by *Mesovelia vagans,* a larger water surface bug.

FAMILY MESOVELIIDAE

Mesovelia mulsanti White. (text figures 11, 12 and 13).

White, F. B. Trans. Ent. Soc. London, 1879: 268. "Hab. Rio Purus (September 24, 1874)". Amazons. Determined by Dr. H. B. Hungerford.

This slender active bug is 3-4 mm. long and of a generally yellowish green color. Adults may be winged or entirely apterous.

The winged form is the more slender and the ocelli are well developed. Its partly whitish wings render it rather conspicuous on its home of blankets of algae or on the leaves of aquatic plants. The apterous form has a wide suboval body while the ocelli are obsolescent.

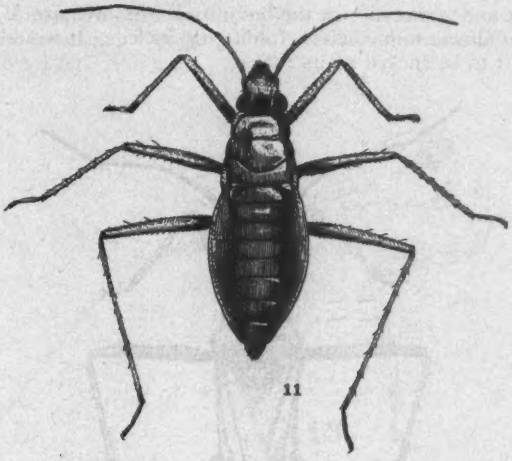

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Fig. 11. *Mesovelia mulsanti*, apterous form.

Although the first record of the presence of this widespread American insect in Hawaii appears to be in 1933 (Proc. Hawaiian Ent. Soc., **8**: 378-379, 1933), when it was taken in a reservoir at Waipio substation, Oahu, it had probably been here for some years previous. It soon appeared in lily ponds and made its way into the mountains where it keeps to the sides and vegetation of the quiet stream pools.

Its biology was little studied. In New York and in Kansas, Hungerford ("Aquatic Hemiptera". Kans. Univ. Sci. Bull., **11**: 101-106; pl. XIV) gives a good account of this insect, the activities of which he studied under a binocular microscope. The insect is found upon floating vegetation and feeds upon the small organisms that come to the surface from below, or that fall upon it. Entomostraca (Crustacea) were thus speared at the surface of the water. The eggs are inbedded in the tissue of certain plants.

Pieces of algal mats, composed largely of *Hydrodyction*, from a lowland reservoir on Oahu were brought to the laboratory and placed in a jar of water. Little *Merragata* bugs and the active young of *Mesovelia* were found in it. Eventually, a young *Meso-*

velia was observed in this jar with an immature *Merragata* skewered on its beak. Although rather chary of the adults of this little bug, *Mesovelia* often pounced upon a young *Merragata,* sometimes holding it down with aid of a foot or grasping it loosely with the legs and probing it for a deadly thrust. Or, *Mesovelia* would use only its beak for the attack. The thrust was sometimes made in a leg joint and sometimes in the body itself; in any case *Merragata* collapsed almost immediately, folding up its legs. It would then be held aloft to be sucked of its juices.

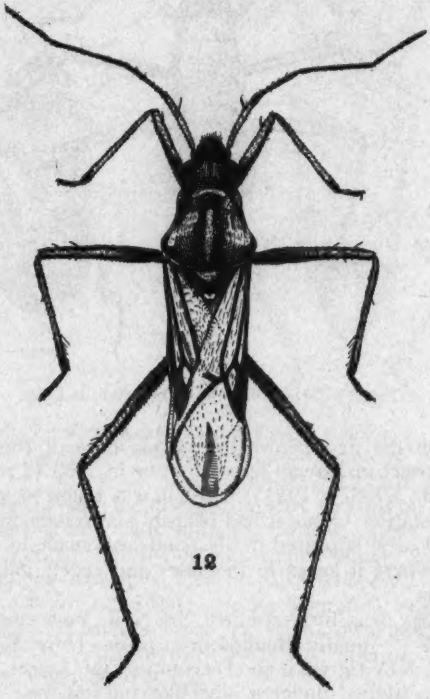

Fig. 12. *Mesovelia mulsanti,* alate form.

FAMILY GERRIDAE

There are no fresh-water striders of this family in the Hawaiian Islands. The pelagic water-striders are medium sized, entirely wingless insects, more or less grayish in color, with stout streamlined bodies and the middle pair of legs hair-fringed apically and

developed for great speed. They are common about tropical shores though also represented in temperate zones. They frequent lagoons and estuaries but may also be found far out at sea. Two species inhabit the Hawaiian area. The bather at Waikiki beach may have observed these insects as they speed over the surface of the water before him and occasionally executing a leap of an inch or two into the air. Certain inshore storms drive these insects in wind-rows along our beaches (Hadden, F. C., Proc. Hawaiian Ent. Soc., **6**: 457-459, 1 fig., 1931).

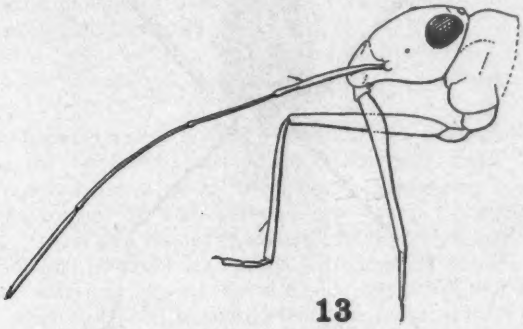

Fig. 13. *Mesovelia mulsanti*, profile of head.

It has been stated by some writers that *Halobates* can and does dive beneath the surface of the water; this faculty would then be useful in avoiding the full force of storms. Dr. R. L. Usinger who has devoted considerable study to these insects was unable to induce *Halobates* to dive beneath the surface ("Biological Notes on the Pelagic Water Striders [Halobates] of the Hawaiian Islands, with Description of a New Species from Waikiki [Gerridae, Hemiptera])"; Proc. Hawaiian Ent. Soc., **10**: 77-84, 3 figs., 1938). I myself doubt that these insects do any diving and believe that many *Halobates* frequently perish in storms, as would likewise a certain proportion of other organisms under adverse conditions in nature.

Eggs of *Halobates* have been found on objects floating in the ocean in other parts of the world. Very young bugs may be observed along the seashores of Oahu.

Dr. Usinger found *Halobates* under captive conditions to be fiercely cannibalistic.

The two species found in Hawaiian waters are *Halobates hawaiiensis* Usinger (l.c., : 79-82) and *Halobates sericeus* Eschscholtz (Entomographien, **1**: 108, tab. II, fig. 4, 1822). Dr. Usinger

found that *H. hawaiiensis,* characteristically gregarious, keeps within the protecting reef; *H. sericeus,* on the other hand is characteristic of the open ocean between the various islands. It is also listed from the Atlantic Ocean.

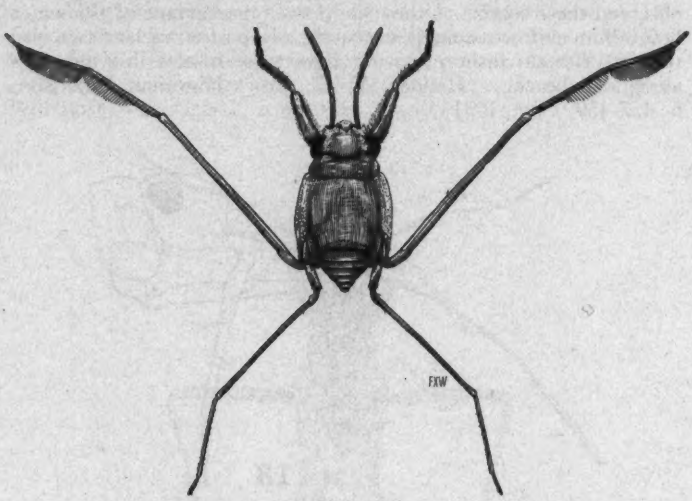

Fig. 14. *Halobates sericeus.* (After Hadden.)

FAMILY VELIIDAE

Microvelia vagans White. (text figure 10).

White, F. B., Ann. and Mag. Nat. Hist., (V) 1: 374, 1878.

This very common little bug is widely distributed in the Hawaiian Islands. It measures about 2.3 mm. long and is represented by both apterous and winged forms. It can be found on stagnant pools, taro ponds, lily ponds, the edges of sluggish streams where there is plenty of algal growth, and even in street gutters in wet districts. It will also find its way into tanks and other large water containers. It is not always on the surface of the water but patronizes the wet leaves and rocks nearby. A fiercely predaceous insect, *Microvelia* gangs up on chironomid flies as these emerge from their pupae at the surface of the water, and may overcome crane-flies issuing from some moss or algal growth. In the cool Mountainview region of the island of Hawaii, in October 1933, I witnessed successful attacks by *Microvelia* on the large pale, dark spotted collembolan, probably *Salina,* that so often finds its way into pools with steep banks. *Salina* is an active leaper upon the surface of the water, nevertheless the bug succeeds in stabbing it in the back, or

it would rush at it from the side. Once stabbed, *Salina* immediately collapsed. The presence in this pool of many dead and sucked-out *Salina* attested to the success of *Microvelia*. Many podurans of lead color were also found dead here, although they did not appear to have been fed upon.

Microvelia lays her eggs on dead leaves in pools, or elsewhere in the wet. The tiny red young may show silvery bubbles of air within the body, and a recently hatched individual clinging submerged to a leaf was observed with its proboscis at the surface, adding bubbles to its supply.

A good biology of *Microvelia borealis* Bueno is given by its describer in Ent. News, **28**: 354-359, 1 pl., 1917.

FAMILY NOTONECTIDAE

The backswimmers are represented in the Hawaiian Islands only by the foreign *Buenoa pallipes* (Fabricius, Syst. Rh.: 103, 1803), (text figure 15), an insect that is commonest in the lowlands but ranges into our mountains to several thousand of feet altitude. It is a pale shining insect with some reddish; well streamlined, and the posterior legs developed for rapid oar-like strokes. The two anterior pairs of legs are relatively small and generally hidden when the insect is viewed from the dorsal side. These legs function as baskets in which to hold an armful of food; to quote Hungerford relative to the food habits of *Buenoa margaritacea* Bueno, a species common on the mainland of the United States (Kansas Univ. Sci. Bull., **11** (17): 194-195, 1919) *"Food Habits.* One striking point in their biology is the adaptation of their two slender anterior pairs of limbs to food getting. The food of these insects of the small entomostracan Crustacea, and the four anterior limbs are margined with rather long spines which form when flexed a splendid crib for the retention of these little animals". Hungerford goes on to say: "They sometimes attack other insects, such as Corixids, but rely almost exclusively upon the little organisms named."

Buenoa while rising from time to time to the surface to renew its air supply, habitually keeps some inches below the surface, maintaining its position there by timely strokes of the posterior legs. Some of our lowland reservoirs teem with tiny crustacea, a *Daphnia*-like species for example being found in veritable clouds some distance beneath the surface. Ostracoda may also abound. Here *Buenoa* thrives. A particularly fine habitat for this bug was discovered many years ago at Haleiwa, Oahu. There on the flat lowlands was a shallow marshy pond already encroached upon by reeds,

succulent *Herpestis* (Scrophulariaceae), etc. It swarmed with small aquatic life. *Buenoa pallipes* (Fabr.) was present in all stages; *Arctocorixa, Merragata* and *Microvelia* abounded; here and there were *Enochrus nebulosus* (Say), a small hydrophilid beetle; the nymph of the endemic lowland damselfly, *Megalagrion xanthomelas* Selys, quantities of the common *Anax junius* Drury dragonfly and veritably swarms of *Pantala flavescens* (Fabr.), our abundant brown dragonfly. In addition, there were plenty of bloodworms (Chironomidae) and smaller organisms.

In captivity *Buenoa* quickly killed and fed upon the larvae of mosquitoes.

The males of *Buenoa* possess the power of stridulation; in *B. pallipes* the sound produced resembles the fine ticking of a watch, or the stridulation of certain small species of locustid grasshoppers,

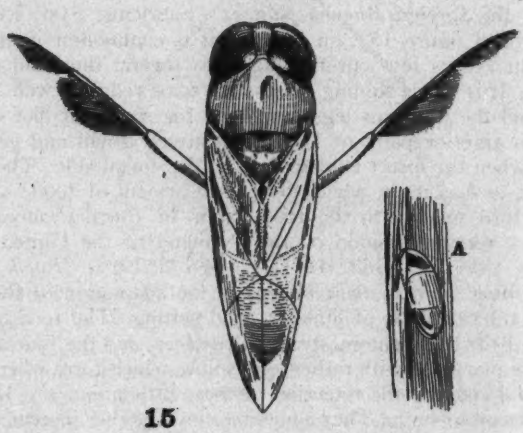

Fig. 15. *Buenoa pallipes;* A, egg embedded in plant tissue.

and it is audible from a distance of several feet. This sound is produced "When the fore limbs are brought up to the head, it will be seen that the stridular areas of the limbs meet those on the base of the beak". (Hungerford, l.c., re *B. margaritacea*).

The eggs of our *Buenoa* were found imbedded in plant tissues.

Unlike *Arctocorixa* in Hawaii, *Buenoa* seems quite unable to endure salt water.

FAMILY CORIXIDAE (The Water Boatmen)

Arctocorixa blackburni (White). (text figure 16).

White, F. B., Ann. and Mag. Nat. Hist., (IV) 20: 114, 1877; ibid (V) 1: 366, 1878. (*Corixa blackburni*) Kirkaldy, G. W., Fauna Hawaiiensis, 2 (6): 554, 1910. (*Arctocorisa blackburni*).

Of this insect, Dr. R. C. L. Perkins says (Fauna Hawaiiensis, 1 (6), Introduction: cciii, 1913): "This family is represented only by *Corixa blackburni* White, a species not known from elsewhere. It is very widely distributed on the lowlands of the islands, inhabiting salt-water pools as well as ponds of fresh water. It comes to light at night sometimes in considerable numbers."

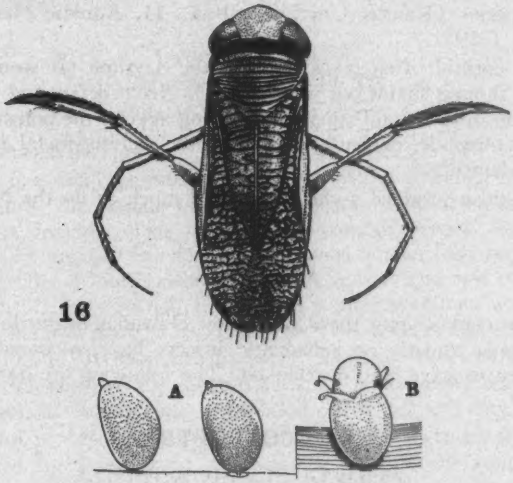

Fig. 16. *Arctocorixa blackburni;* A, eggs; B, young hatching from egg.

Our water boatman measures about 4.5 mm. long. The back of the thorax is finely banded with blackish while the elytra are finely but irregularly banded with brownish to black. The long posterior legs are hair fringed for propulsion by swift strokes.

Although the water boatman has been taken in a clear stream at over 2000 ft. elevation on Molokai, I have found it numerous only in the lowlands. It may fairly swarm in salty pools separated from the ocean by a low sandbar and having a salinity of approximately 5 per cent, or saltier than the sea itself. In this same salty medium we may find *Enochrus nebulosus,* the hardy little hydro-

philid beetle. *Arctocorixa* also thrives in lowland ponds on a base of mud and coral and where the water is fresh or nearly, and well stocked with other aquatic insects. The bug seems not to suffer from the presence of small fish that share the pool. It is a bottom insect, coming to the surface only for air or to take flight. I have seen swarms of this insect, nearly all immature, swimming steadily and mainly in one direction in a salty pool by the sea beach. The short-stemmed eggs are secured to submerged algae or other available material; they may be present in great quantity and appear like little white beads. I have kept *Arctocorixa* in sea water for over two weeks, and have seen a single individual at Waikiki swimming and diving in shallow water about 130 feet out from the shore.

It is probably chiefly herbivorous, as Hungerford has shown for other species (Kansas Univ. Sci. Bull., **11**, Aquatic Hemiptera, 234-249, 1919).

Our corixid often takes flight in the daytime. It would seem that the shining surface of water attracts *Arctocorixa*, and we have seen them in the bright sunshine crashing against the polished hood of an automobile, evidently mistaking the shining metal for their proper element.

Corixidae produce a chirping sound much as do the Notonectidae.

ADDENDA

Since commencing these papers on Hawaiian water-loving insects, other aquatic or subaquatic insects have appeared in the Territory, or have been overlooked. The following are now listed:

Order **COLEOPTERA**

Family CURCULIONIDAE

Stenopelmus rufinasus Gyllenhal.

Mr. E. C. Zimmerman has the following to say regarding this small robust insect:

"Four specimens of this semi-aquatic weevil were collected by Dr. H. Lyon from *Azolla* at Honolulu, in November 1909. It has remained undetermined in the Sugar Planters' collection and has evidently not been collected since that time. It may not have been established here, but it is worthwhile to record it. Its small size and peculiar biology, however, may have kept it hidden from collectors. . . ." (Proc. Hawaiian Ent. Soc., **10**: 131, 1938). It is widely distributed in the United States.

Order **TRICHOPTERA**
Family HYDROPTILIDAE

Oxyethira sp.

This interesting find was made by Mr. E. C. Zimmerman in October, 1940, in Moanalua Gardens, Honolulu. (Proc. Hawaiian Ent. Soc., **11**: 350-352, 1943). He collected "a series of a minute, moth-like insect flying about at noon day near the banks of a small garden stream and nervously running about on the bare ground and searching into cracks in the soil. . . ." "The species is evidently not American, and is unknown to Nathan Banks, who kindly examined it. . . ." "It is probable that this species of *Oxyethira* has gained entrance to Hawaii by accompanying imported aquatic plants. . . ."

Order **ODONATA**
Suborder ZYGOPTERA
Family COENAGRIONIDAE

Enallagma civile Hagen.

This is a small damselfly, the male with the abdomen blue with black bands, the female of duller coloration, the abdomen being somewhat grayish. This insect was so outstandingly distinct in facies from our own fine species that it was immediately recognized as an intruder in the Hawaiian odonate fauna. The first record of its capture here is July 4, 1936, when a male specimen was taken on a hillside in Manoa valley, Honolulu (Proc. Hawaiian Ent. Soc., **9**: 368, 1937). It soon became very abundant in Honolulu and appeared on some of the other islands. It is common about reservoirs, lowland swamps and other bodies of water and may be seen in numbers in waste places and in gardens where there are no breeding places for it apparent. We find it also on the summits of mountains behind Honolulu.

Ischnura posita (Hagen).

Mr. Charles Hoyt of Honolulu first found this very small damselfly here. It was breeding in the Punahou School lily pond, Honolulu (Proc. Hawaiian Ent. Soc., **9**: 370, 1937). It is now an abundant insect. It is common on the mainland of the United States. Our specimens were determined by Mr. John Cowley.

These two damselflies are probably of some economic importance as destroyers of mosquitoes. They gained entrance into the Hawaiian Islands presumably through the importation of aquatic plants.

A Case of Bovine Auricular Myiasis and Some Ectoparasites New to Hawaii

BY ELWOOD C. ZIMMERMAN

Entomologist, Bernice P. Bishop Museum

(Presented at the meeting of September 13, 1943)

On August 16, I attended an autopsy of a cow at the animal quarantine station in Honolulu for the purpose of searching for ectoparasites. The animal, which was in a run down condition, had been brought from the island of Molokai by the Territorial Veterinarians Dr. Willers and Dr. Hendershot for study of an apparent nutritional disease. The cow was butchered immediately after being shot. When the rumen was opened, I saw a full grown fly maggot crawling about in the food-mass. Upon searching for the source of the maggot, it was found that the animal's ears were packed with writhing masses of hundreds of fly maggots ranging in age from young to mature individuals. The maggot found in the rumen had evidently been licked up and swallowed by the cow. One of the ears was cut off, and some of the maggots from each ear were brought back to the laboratory. In due course, 275 *Chrysomyia megacephala* (Fabricius) and 39 *Chrysomyia rufifacies* (Macquart) adults were reared. In addition to this reared material, I saw a few larvae of a species of *Fannia* when the slaughterer cut open one of the ears and threw out a mass of maggots with his knife. Unfortunately, the *Fannia* material was lost.

A few days before killing the animal, Dr. Hendershot, who was responsible for my being present at the autopsy, removed a series of ticks from the cow's ears. I have identified the ticks as the argasine *Ornithodoros megnini* (Dugès), the spinose ear tick. There were other specimens of the tick present in the ears when I examined them. Perhaps sores developed in the ears after the ticks were removed and these sores were struck by the flies.

During the rearing of the *Chrysomyia* species, three specimens of the fly *Discomyza maculipennis* (Wiedemann) (Ephydridae) were reared. In spite of the precautions taken to prevent contamination of the culture, it is probable that the ephydrid gained entrance to the jar containing the ear and was not present when the ear was removed from the cow. However, I cannot be certain of this. This ephydrid has previously been reared only from dead sea shells in Hawaii and little is known of its biology.

During the preparation of my manual "Insects of Hawaii", I have collected or identified several species of ectoparasites which have heretofore apparently not been mentioned in Hawaiian literature. Some of these are now placed on record for the convenience of local workers.

I understand that the spinose ear tick mentioned above has been found on Oahu, Molokai, Maui and Hawaii.

A mite which has caused some trouble to human beings, and which has been lately studied by Mr. Pemberton and me, has been identified by Dr. Ewing as *Liponyssus bursa* (Berlese), the tropical fowl mite. We have found the mite common in the nests of English sparrows and mynah birds. Honolulu physicians have reported several cases of mite bite irritation resulting from the invasion of houses (especially bedrooms) by this minute mite. The mites can blow through ordinary screen from nests under the eaves of dwellings.

The sucking louse *Polyplax spinulosus* (Burmeister) has not been listed from the Territory, but I have seen specimens collected from rats in Honolulu.

I collected the sucking louse *Linognathus africanus* Kellogg and Paine from goats at Kahala, Honolulu in May, 1943.

The biting louse *Gliricola porcelli* (Linnaeus) was collected from Guinea pigs in Honolulu in June, 1943.

The cow discussed above was heavily infested with the biting louse, *Bovicola bovis* (Linnaeus).

In 1920, Mr. Swezey collected *Bovicola caprae* (Gurlt) from a goat in Honolulu.

I have examined specimens of the biting louse *Felicola subrostrata* (Nitzsch) at the Hawaiian Sugar Planters' Experiment Station taken from cats in Honolulu.

The biting louse *Columbicola columbae* (Linnaeus) was recently collected from pigeons in Honolulu.

Pembertonia, A New Genus of Papuan Cossoninae (Coleoptera, Curculionidae)

BY ELWOOD C. ZIMMERMAN

Entomologist, Bernice P. Bishop Museum

(Presented at the meeting of December 13, 1943)

To those who study the enormous family Curculionidae, or weevils, the seemingly endless array of forms and structural diversification becomes ever more remarkable and overwhelming. Peculiar

new species and genera still come to hand much faster than the overburdened taxonomists can possibly make them known to science. In spite of the fact that about 40,000 species have been described, the family is poorly known. There yet remain vast areas of the tropical world where most of the thousands of species are unknown. The difficulties of treating these myriads systematically need hardly be emphasized, and the amazing morphological diversity makes the task appear, at times, hopeless. The very characters which have long been used to separate genera and supra-generic categories have broken down time and time again, even in groups which we have long thought to be well characterized and stable. One is at a complete loss to anticipate what revolutionary new forms may come to light when the fruits of arduous field work are examined under the microscope. Mimetic-like forms may be assigned to certain genera after cursory examination, only to be found after detailed study to belong to widely separated subfamilies. Other forms which appear certainly to belong to different subfamilies prove to be only confusing members of a single genus. For these and other reasons, our literature for about the past 80 years has been largely devoted to recording and descriptive work, and comparatively little has been done on the larger problems of supra-generic classification. Because of the difficulties of the task, there are no synoptic diagnoses nor keys to the more than 70 subfamilies now recognized in the world. It is true, however, that there are local works which partially cover the comparatively impoverished European or North American faunas, but there is no world-wide monograph to aid the floundering worker. The great Schoenherr treated all the genera and species known to him a century ago—it took about 15 years of concerted effort on the part of him and his several collaborators to fill the several thousand pages of his *opus*. Today, a similar accomplishment is impossible.

This paper is written to place on record a strange new genus which I assign to the Dryophthori of the Cossininae. We have come to believe that the Dryophthori form a compact and distinct group which is peculiar in that its members have the tarsi 5-segmented, whereas the normal compliment in the Curculionidae is four. However, this new creature has all the essential attributes of the Dryophthori, yet the very character which signalizes that group is wanting, for it has 4- instead of 5-segmented tarsi! In spite of this structural anomaly, the insect is otherwise a typical dryophthorid, and to separate it from its obvious allies would be gross error.

It is with much pleasure that I dedicate the genus of this remarkable new weevil to its collector, Cyril E. Pemberton, Executive Entomologist, Hawaiian Sugar Planters' Experiment Station, an

economic entomologist who keenly appreciates the values of pure scientific research to the applied fields of his endeavor.

Pembertonia, new genus

Body Dryophthorus-like in form, sculpture and vestiture; lutose, dorsal vestiture sparse and velutinous.

Head with crown exposed from above; interocular area narrower than base of rostrum; eyes largely lateral, coarsely faceted, subcontinuous in outline with head.

Rostrum subcylindrical, longer than head, but not as long as pronotum; scrobes invisible from above, beginning behind middle and passing rapidly to under side.

Antennae with scape reaching only to fore edge of eye, longer than funiculus excluding club, funiculus 4-segmented, first two segments larger than distal two; club about as long as funiculus, mostly shiny and sparsely pubescent except for apex which is densely pilose (apical half conspicuously, obliquely truncated on genotype, but this may not prove to be a generic character).

Prothorax well developed, base convex, subapically constricted; postocular lobes absent.

Scutellum small, inconspicuous.

Elytra with distinct humeri, broader than prothorax, distinctly 10-punctate-striate.

Wings developed for flight.

Legs with femora not distinctly clavate, unarmed, not grooved beneath. hind pair reaching about to apex of elytra; tibiae comparatively straight, with a strong terminal uncus, but not mucronate, longitudinally carinate; tarsi 4-segmented, the true fourth segment invisible, first three segments pilose, the third entire at apex, fourth segment slender, elongate, bare; claws small, slender.

Sternum with anterior margin of prosternum emarginate at middle, much longer in front of than behind fore coxae; fore coxae contiguous; mesosternum sloping; mesocoxae separated by much less than breadth of a mesocoxa; metasternum about as long along median line as first two ventrites, distance between inner margins of metacoxae nearly equal to distance between outer edges of mesocoxae, outer edges of metacoxae very nearly touching elytra; met-episternum invisible.

Abdomen with ventrite I longer than II plus III along median line, on a plane distinctly ventrad of that of the remainder of abdomen; intercoxal piece subtruncate, but with an anterior median projection; ventrite II sloping, longer than III plus IV; ventrites IV and III narrow, together about as long as V.

Genotype: *Pembertonia seftoni,* new species.

This genus resembles *Dryophthorus,* but it can be distinguished principally because of its four-segmented rather than pentamerous tarsi and its contiguous fore coxae. Other characters which may prove to be useful as generic distinctions are the peculiarly oblique apex of the antennal club, the scape not passing behind the fore margin of the eye, and the fact that the hind edges of the eyes are narrowly hidden beneath the edges of the prothorax, although these latter characters may be subject to variation.

With the discovery of this aberrant genus, the possibility is brought forward that perhaps future collecting and study will reveal a number of variformed genera which are centered around *Dryophthorus* in addition to the few thus far known.

Fig. 1.

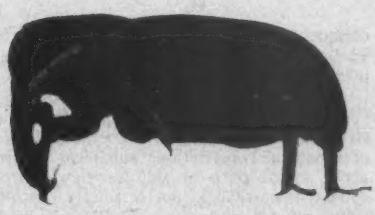

Fig. 2.

Figs. 1 and 2.—Dorsal and lateral views of holotype of *Pembertonia seftoni*, new genus and species (photographs by W. Twigg-Smith, courtesy of Hawaiian Sugar Planters' Association).

Pembertonia seftoni, new species (figs. 1-4).

Female. *Color:* derm coal-black, almost completely alutaceous and dull; tarsi piceous; vestiture gray and brownish-gray; incrustation brown.

Head with crown broadly convex, evenly set with well separated, medium sized, round punctures, the interstices as broad or broader than the punctures, without distinct setae; interocular area with a distinct median depression between dorsal edges of eyes, narrowest distance between eyes two thirds breadth of base of rostrum; eyes five facets broad at middle, about twice as high as broad, as widely separated beneath as breadth of base of rostrum, lower edges narrowly concealed by prothorax.

Rostrum about nine tenths as long as pronotum, arcuate, almost cylindrical, subequal in diameter at base, at antennal insertion and at apex; densely punctate from base to apical fifth, punctures toward sides subconfluent or confluent; punctures with the peculiar dryophthorid velutinous vestiture, which is longest and densest on sides beyond antennae; apical fifth bare, impunctate, moderately shiny, with a broad, shallow, rather obscure, median, apical impression; ventral surface with a prominent median carina from base nearly to oral cavity and flanked on either side by a narrow, incrustation-filled or pilose sulcus, and scrobes distinctly impressed beneath.

Antennae inserted at about basal two fifths of rostrum in female holotype; scape stout, clavate, about as long as funiculus plus one half length of club, as thick at widest part as length of funicular segments III plus IV; funicular segment I as broad as, but somewhat longer than II, rounded at apex, II subtriangular, about as long as broad, as long as III plus one half of IV, apex truncate, III and IV transverse and twice as broad as long; club about as long as funicular segments I and IV, three fourths as broad as long,

Fig. 3.

Fig. 4.

Figs. 3 and 4.—Outline diagrams of antenna and tarsus of *Pembertonia seftoni* Zimmerman.

obliquely cut off on side toward scape for nearly one half its length at a 45-degree angle, the truncated area densely pilose, elsewhere with scattered prostrate setae.

Prothorax nearly as broad as long (25:27 units in holotype), broadest very near base, and there hardly broader than at hind edge of subapical constriction (25:24 units in holotype), sides straight from base to hind margin of subapical constriction; subapical constriction abruptly incised, situated at about apical fifth of side as viewed from above, but extending obliquely caudad toward disk, not distinctly continued across dorsum, but marked on sides and sternum; longitudinal dorsal contour slightly, almost evenly convex; punctures large, rounded, distinctly smaller cephalad of subapical constriction, capped with thin, brown, parchment-like incrustation, but punctures beyond subapical constriction with velutinous vestiture, setae inconspicuous, intervals narrower than punctures.

Scutellum inconspicuous, much smaller than an adjacent prothoracic puncture.

Elytra fully three fourths as broad as long, somewhat more than twice as long as prothorax, broadest between humeri and middle, breadth across humeri about one and one half times as broad as base of prothorax; base broadly emarginate; humeri prominent and at angles of about 45 degrees; sides convergently arcuate to near apex where there is a distinct break in the contour caused by subapical constriction and a small tuberculiform process situated at position where intervals III to IX would join if extended; striae well and regularly marked, but not impressed between punctures, punctures subquadrate and similar in size to those on disk of pronotum, broader than intervals, stria IX joining X above metacoxa, setae inconspicuous; alternate intervals, especially I, III and V, appearing slightly more elevated than others, and I, III and V with almost continuous velutinous vestiture, vestiture of other intervals arranged in small spots, without distinct setae.

Legs with femora densely set with moderately coarse punctures bearing conspicuous compound setae or velutinous pile; tibiae densely clothed with rather matted pile, with the longitudinal carinae showing through; tarsi with segments I to III clothed with short velutinous pile with longer setae beneath, IV bare, segment I about as long as II plus one half of III, about one third longer than broad, II about as long as broad, somewhat shorter than III, III slightly longer than broad, as broad as II, IV as long as II plus III, imbedded nearly to middle of III and about one half as broad as III.

Sternum with anterior prosternal margin so emarginate that distance on median line from anterior margin to ventral extension of subapical constriction of prothorax is only about one third or less that on side as viewed from directly beneath, area in front of coxae sloping strongly upward, coarsely punctured, distance behind coxae hardly one fourth length of a fore coxa; mesosternum subtuberculiform between mesocoxae and at a level distinctly ventrad of that of metasternum, without conspicuous punctures at sides above

coxae, sutures of side pieces obscure; metasternum with punctures of disk rather small, separated by one and one half to more than twice their diameters, punctures along fore margins and at sides larger.

Abdomen with ventrite I tumid in female holotype, with a row of large marginal punctures, but those on disk similar to those on disk of metasternum; ventrite II with a row of dense, coarse punctures along fore margin and a well separated row at about middle; ventrites III and IV with their bounding sutures unusually broad, coarse and deep, sulciform, the sutures ending in marginal punctures and thus appearing to be turned slightly backward at sides, the ventrites costiform, with small punctures; ventrite V coarsely sculptured, subapically setose; pygidium shallowly impressed down middle, apex subtruncate.

Length (excluding head): 4.0 mm.; breadth: 1.9 mm.

New Guinea. Holotype female, stored in the type collection of Bishop Museum, collected by Cyril E. Pemberton at Koitaki at 1,500 feet elevation in November or December 1928. (Koitaki is in a wet district about 30 miles into the mountains from Port Moresby on the Laloki River.)

This species, which appears to be a *Dryophthorus* at first sight, probably has habits similar to *Dryophthorus*, and future collectors may find it under damp, rotting bark or in rotting wood.

At Mr. Pemberton's request, I have dedicated this species to T. L. Sefton, manager of Koitaki Rubber Estates, Ltd., Papua, in appreciation of his cooperation and aid to the field researches of Mr. Pemberton, and on whose plantation it was discovered.

Two New Amblycnemus from Larat Island (Coleoptera, Curculionidae)

BY ELWOOD C. ZIMMERMAN

Entomologist, Bernice P. Bishop Museum

(Presented at the meeting of December 13, 1943)

In 1931, Sir Guy Marshall described the anthonomine genus *Amblycnemus* to receive a Samoan species, and since then several other species have been described. Although many new species await description in the collections now before me, I have seen only two species from the Papuan subregion. This paper includes the descriptions of these two new species from the collection of the

Hawaiian Sugar Planters' Experiment Station which are from Larat Island (in the Tenimbar group between New Guinea and Timor), and it is writen principally to record the new zoogeographical data. With the present knowledge of the widespread distribution of the genus, we can safely say that it probably includes a large number of species. Undoubtedly many species inhabit the New Hebrides, Solomons, Bismarck and Papuan islands, and the genus may extend farther westward. Moreover, a number of allied new genera are among materials collected by me, and others surely remain to be discovered, for there is probably a whole group of genera centered around *Amblycnemus*.

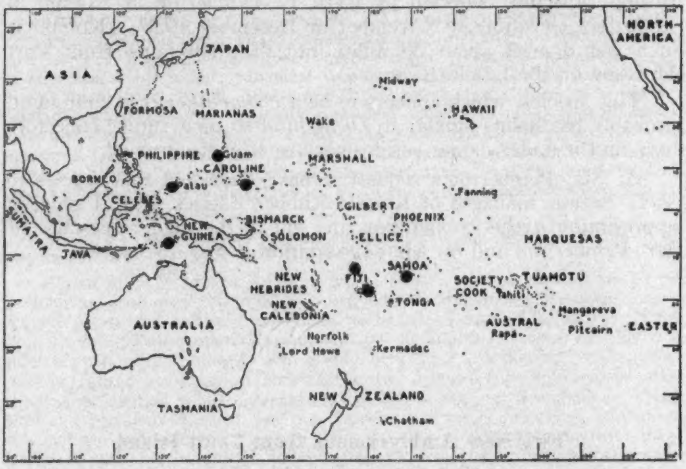

Fig. 1.—Map showing known distribution of the species of *Amblycnemus*.

The extraordinary resemblance in size, shape, color and color pattern of some of the species to members of the large cryptorhynchine genus *Trigonopterus* (*Idotasia*) is remarkable. And like members of that genus, the species of *Amblycnemus* which I have collected have rather similar habits as adults. That is, they may be most commonly found walking about on, or resting on, the leaves of various trees, shrubs and herbs in the forests. They seem to prefer large, shiny leaves. Nothing is known of their early stages.

The holotypes and allotype of the new species are stored in the type collection Bishop Museum, and paratypes are also in the collection of the Hawaiian Sugar Planters' Experiment Station.

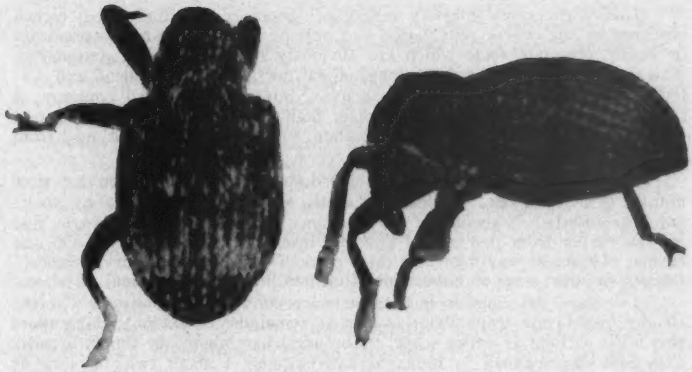

Fig. 2. Fig. 3.

Figs. 2 and 3.—Dorsal and lateral views of holotype of *Amblycnemus fasciatus*, new species (photographs by W. Twigg-Smith, courtesy of Hawaiian Sugar Planters' Association).

The species of the genus thus far described are as follows:

1. **Amblycnemus stevensoni** Marshall, genotype.[1]
   Insects of Samoa, **4** (5) : 266, fig. 6, 1931.
   Tutuila and Upolu Islands, Samoa.
2. **Amblycnemus dentifer** Zimmerman.
   Proc. Haw. Ent. Soc., **11** (1) : 95, 1941.
   Melekeiok, Palao Islands, and Truk, Caroline Islands.
3. **Amblycnemus dentipes** Zimmerman.
   Bishop Mus. Bull. **172** : 96, pl. 6, fig. F, 1942.
   Guam, Marianas Islands.
4. **Amblycnemus fulgidus** Zimmerman.
   Bishop Mus. Occasional Papers, **17** (14) : 185, fig. 1, *a*, *b*, 1943.
   Rotuma Island.
5. **Amblycnemus fasciatus** Zimmerman, new species.
   Larat, Tenimbar Islands.
6. **Amblycnemus laratensis** Zimmerman, new species.
   Larat, Tenimbar Islands.

Amblycnemus fasciatus, new species (figs. 2, 3).

Male. *Color:* derm reddish brown to piceous; elytra with a broad, dark, or black fascia just before middle, a similar fascia just behind middle and entire apical fifth dark, these fasciae probably subject to some individual variation; setae white and conspicuous; entire derm moderately coarsely reticulate or alutaceous and comparatively dull over all.

[1] Note: in my paper, Curculionidae of Guam, Bishop Mus. Bull. **172**: 95, 1942, there are three serious typographical errors in the references to this genus and species. For 1921, read 1931 in both places, and for p. 226, read p. 266.

Head with crown coarsely reticulate; punctures medium sized, rather obscured by the coarse reticulation and bearing anteriorly directed prostrate or nearly prostrate setae which are obviously smaller and less conspicuous than those on interocular area; longitudinal dorsal contour of head and rostrum continuous; eyes moderately convex, interrupting lateral contours of head; interocular area slightly narrower than base of rostrum, with conspicuous, suberect, curved, narrowly lanceolate, squamiform setae continued from rostrum to tops of eyes.

Rostrum, in male, with its lower chord about one fourth longer than pronotum, gently arcuate, gradually, slightly expanded from base to apex; antennae inserted at about one third distance from apex; with a single, fine median carina from just behind antennal insertion to base, lateral sulci and carinae obscure or wanting; with three rows of conspicuous, decurved, lanceolate squamiform setae on either side of median line behind antennal insertions.

Antennae (described from left antenna removed from holotype) with the slender but clavate scape about as long as remainder of antenna, clava about two fifths as long as entire scape, its broadest part about one fourth broader than funicular segment I; funiculus with segment I about twice as long as broad, almost as long as segments II plus III, segment II somewhat longer than III, III to VI successively shorter and broader; club approximately as long as first two funicular segments together.

Prothorax slightly transverse (21 units wide to 17 long in holotype), broadest at about basal third, subapical constriction broad and shallow, only shallowly interrupting the otherwise slightly arcuate dorsal contour at apical third; punctures moderately coarse, dense, interstices between them narrower than diameters of punctures; with conspicuous, decurved, squamiform setae similar to those on rostrum, most abundant on sides, at apex and on either side of median line.

Scutellum bare, rounded, convex.

Elytra about three fourths as broad as long, three times as long as prothorax, broadest at about middle, breadth across humeri about one and three quarters times as broad as prothorax; base sinuous; sides just perceptibly narrowed behind humeri, thence broadly arcuate to the broadly rounded apices, subapical constriction obsolete, longitudinal dorsal contour almost evenly arcuate throughout; striae deep and distinctly impressed throughout, stria ten not continued beyond hind coxae; strial punctures distinct and conspicuous, those toward base large, coarse, subquadrate, and as broad or broader than intervals, but becoming smaller caudad and those behind middle less distinct and narrower than intervals, some of the punctures bearing decumbent, squamiform setae similar to but smaller than those on intervals; intervals distinctly convex, bearing conspicuous, well separated, white, narrowly lanceolate, decurved, squamiform setae in single rows excepting for a few extra setae at base and about middle of interval three.

Legs with femora shallowly and indistinctly punctured, bearing conspicuous, white, narrow, decurved setae, hind pair not extending behind third ventrite and armed beneath with a conspicuous, acute tooth, middle pair with a minute denticle and fore pair unarmed in holotype; tibiae not carinate, bearing finer, less conspicuous setae than those on femora, evidently unarmed at apices; tarsi with some of the dorsal setae stouter than others and elongate-sub-squamiform, third segment deeply bilobed and as broad as length of II plus III.

Sternum with prosternal canal densely set with plumose setae, side walls in front of coxae low, almost straight, simple, only slightly and indistinctly elevated behind fore coxae; mesocoxae separated by about the breadth of a mesocoxa; metasternum with disk shiny, sides dull, shortest distance between mid and hind coxae about equal to length of a metacoxa, with large, con-

spicuous, setiferous punctures around edges, sides coarsely and deeply punctured, the punctures broader there than on disk; metepisternum with a single row of narrowly spatulate, squamiform setae and with a row of similar setae on mesepisternum.

Abdomen tumid, first ventrite broadly arcuate between coxae, impressed in middle in male, punctures coarsest and closest along fore margin, punctures bearing fine, decurved setae, length along median line about equal to length of ventrites II to IV inclusive; suture between I and II obliterated at middle; ventrite II with small, scattered, setiferous punctures; ventrites III to V inconspicuously punctate and setose; ventrite V almost as long as III plus IV.

Length (excluding head and rostrum): 1.75 mm.; breadth: 0.9 mm.

Larat Island. Holotype male collected in December 1907 by F. Muir.

This species belongs to the *dentifer-dentipes* group of the genus, and it is closely similar to each of those species. It most closely resembles *A. dentipes* from Guam, but that species and *A. dentifer* each have all the femora dentate and on each of those species the hind femora are longer than on *A. fasciatus*. There are other characters, such as the proportions of various structures and parts of the body, that will also serve to distinguish these three species.

A. dentifer, A. dentipes and *A. fasciatus* form a group of species which is most distinct from *A. fulgidus* and *A. laratensis*, with the genotype, *A. stevensoni*, in between. In fact, before they are critically examined, such species as this new one and *A. fulgidus* hardly appear to belong to the same genus.

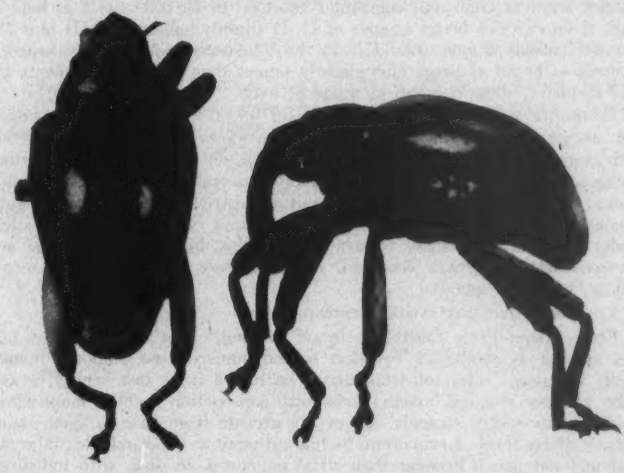

Fig. 4. Fig. 5.

Figs. 4 and 5.—Dorsal and lateral views of *Amblycnemus laratensis*, new species (photographs by W. Twigg-Smith, courtesy of Hawaiian Sugar Planters' Association).

Amblycnemus laratensis, new species (figs. 4, 5).

Color: derm piceous to black, moderately shiny above; squamae white; elytra each with a subapical vitta of white scales, dorsum otherwise without markings.

Head densely punctate, but with the coarse reticulation sometimes obscuring the individual punctures; each puncture on crown containing a narrow, anteriorly directed, prostrate or subprostrate squamiform seta, with two rows of more conspicuous scales on sides behind each eye; interocular area not more than one half as broad as base of rostrum, with a narrow median carina and a row of subprostrate or reclinate, lanceolate or subspatulate setae in the sulcus on each side of the median carina; longitudinal, median dorsal contour of front continuous with that of rostrum; eyes only slightly convex, not protuberant.

Rostrum in male with its lower chord about 1.3 times as long as pronotum, compressed at base and there about 0.8 as broad as depressed apex or about 0.8 as broad as height of base, gently arcuate, antennae inserted between distal one fourth and one third, carinae and intervening sulci conspicuous, with three dorsal and two lateral carinae (the outer lateral carinae at the dorsal scrobal margin) and with a short, somewhat obscure subbasal lateral carina between the outer dorsal and inner lateral carinae; sulci between carinae with conspicuous, mesially or mesad-cephalad directed lanceolate or narrowly subspatulate squamae; essentially similar in female, but more slender and with carinae and sulci less strongly developed, the median carina absent and setae fine instead of squamiform.

Antennae with the slender scape not quite as long as funiculus plus first segment of club, feebly clavate, hardly broader at its broadest part than first funicular segment; funicular segment I subequal to II, fully twice as long as broad, about twice as broad as apex of II, II slightly longer than III plus IV, III conspicuously longer than IV, IV to VI successively slightly broader, VI about as broad as long; club slightly longer than funicular segments III to VI inclusive, about one half as broad as long.

Prothorax distinctly transverse (about 40:27), broadest within basal third, arcuately narrowing from base to the narrow subapical constriction which is very near apex; subapical constriction not or indistinctly interrupting the otherwise evenly convex longitudinal dorsal contour; base strongly sinuous; distance across dorsum at subapical constriction approximately equal to length of pronotum; punctures medium sized, separated by interstices broader than their diameters toward base of disk, but distinctly denser and with narrower interstices cephalad, each puncture bearing a fine, inconspicuous, prostrate seta.

Scutellum bare, disk usually depressed.

Elytra about three fourths as broad as long, about three and one half times as long as prothorax, broadest behind humeri; base sinuous; humeri broadly angulate; sides sub-triangularly narrowed from just behind humeri to the broadly rounded apices; subapical constriction feeble; longitudinal dorsal contour rather strongly and evenly arcuate from base to apex, rising distinctly above level of pronotum, its highest point at about middle; intervals broad and flat, much broader than strial punctures on disk, with indistinct, microscopical setae only, but with a conspicuous vitta of broad, white, spatulate squamae, on apical part of interval three which begins at a point about opposite the apices of striae three and four; striae not impressed except near sides and at apex, but with regular rows of medium sized, distinct, well separated punctures, ninth stria merging with tenth above first ventrite.

Legs with femora densely and coarsely punctate, each puncture bearing a conspicuous seta, those on the dorsal edges of mid and hind pair (rarely on fore pair), and especially on hind pair, mostly squamiform, subspatulate and conspicuous, thus the hind pair at least with a white dorsal vitta; hind femora reaching about to apex of elytra, with a well developed, narrow, sharp tooth beneath, middle pair with a smaller tooth and fore pair with or without a small tooth (obscure or absent in female); tibiae distinctly multi-carinate, with fine, curved, subprostrate setae in the sulci, mid and hind pair of male mucronate (but with the mucrones usually obscured by the terminal setae), female without tibial mucrones; tarsi with third segment deeply bilobed, about twice as broad as long, slightly broader than length of II plus III.

Sternum with prosternal canal with only a few setae, side walls in front of coxae distinctly notched so as to form two tooth-like tubercles when viewed from side, but these usually somewhat obscured by setae and an exudate in the fovea on side of prothorax at base of the side walls; side walls not distinctly elevated behind coxae; mesocoxae about as widely separated as breadth of a mesocoxa; metasternum with ventral part shiny, punctate around edges and with fine setae in the punctures, outer vertical parts below pleura with large, white squamae borne from the coarse punctures, a deep, longitudinal, fovea-form, apical depression on median line, distance between mid and hind coxae approximately equal to length of a metacoxa; pleura without distinct setae or squamae, metepisternum with a single row of punctures.

Abdomen with first ventrite broarly concave, more deeply so in male than female, disk with distinct, but comparatively shallow punctures bearing decurved setae, length along median line equal to length of II to IV inclusive, suture between I and II obliterated in middle; ventrite II with rather obscure punctures bearing fine setae; ventrites III and IV coarsely reticulate and without conspicuous punctures or setae; ventrite V densely set with setiferous punctures, coarsely reticulate and with a conspicuous, deep, subapical median fovea.

Length (excluding head and rostrum): 2.5-2.9 mm.; breadth: 1.3-1.5 mm.

Larat Island. Holotype male, allotype female, five female paratypes, 16 male paratypes, four teneral males and two teneral females collected in December 1907 by F. Muir.

This species more closely resembles *A. fulgidus* than any of the other described species. It is, however, quite distinct from that species. The fovea on the fifth ventrite is peculiar.

New Insect Records for the Year 1943

BY THE EDITOR

The following list of insects recorded for the first time in Hawaii during the past year, is a continuation of a record begun in the Proceedings by Mr. O. H. Swezey with a list of the immigrants for 1919 (Proc. Haw. Ent. Soc., **4** [2] : 448, 1920). Species marked with an asterisk were observed for the first time in 1943, on the date mentioned in the text. The others were observed here prior to that year, but have only now been identified. For details of the records refer to the pages indicated.

Chance Immigrants

Eriophyes litchii Keifer (Acarina)..... 6 (footnote)
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***Aphis ferruginea-striata** Essig (Homoptera-Aphididae)..... 17
***Aphis tavaresi** Del Guercio (Homoptera-Aphididae)..... 17
Neophyllaphis araucariae Takahashi (Homoptera-Aphididae)..... 17
Acrolepia assectella (Zeller) (Lepidoptera)..... 19, 22
***Hormius pallidipes** Ashmead (Hymenoptera)..... 17, 22
***Apanteles dignus** Muesebeck (Hymenoptera)..... 17, 22, 91
Cardiocondyla emeryi Forel (Hymenoptera)..... 25
***Latrodectus mactans** var. **hesperus** Chamberlin & Ivie (Arachnida)..... 26
Podagrion mantis Ashmead (Hymenoptera)..... 92
Amphorophora sonchi (Oestlund) (Homoptera-Aphididae). Previously recorded in Hawaiian Agr. Expt. Sta. Rept. (1940) : 44, 1941, but not noted before in these Proceedings..... 95
Aphis rumicis Linn. (Homoptera-Aphididae)..... 95
Brachycolus heraclei Takahashi (Homoptera-Aphididae)..... 96
Macrosiphum rosaefolium Theobald (Homoptera-Aphididae)..... 97
Myzus convolvuli (Kaltenbach) (Homoptera-Aphididae)..... 97
Spaniotoma (Smittia) maculiventris Edwards (Diptera)..... 164
Ornithodoros megnini (Dugés) (Ixoidea)..... 199
Liponyssus bursa (Berlese) (Acarina)..... 200
***Polyplax spinulosus** (Burmeister) (Anoplura)..... 200
***Linognathus africanus** Kellogg & Paine (Anoplura)..... 200
***Gliricola porcelli** (Linn.) (Anoplura)..... 200
***Bovicola bovis** (Linn.) (Anoplura)..... 200
Bovicola caprae (Gurlt) (Anoplura)..... 200
Felicola subrostrata (Nitzsch) (Anoplura)..... 200
***Columbicola columbae** (Linn.) (Anoplura)..... 200

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